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**EVALUATING THE IMPACT OF THE FOOD STAMP
PROGRAM IN THE 1980s**

A FINAL RESEARCH REPORT

SUBMITTED TO

**UNITED STATES DEPARTMENT OF AGRICULTURE
FOOD AND NUTRITION SERVICE**

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United States
Department of
Agriculture

Food and
Nutrition
Service

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SUBJECT: 1991 Small Grant Draft Research Report,
"Evaluating the Impact [on Poverty] of the Food Stamp
Program in the 1980's"

TO: Mike Fishman
Steve Carlson
Bob Dalrymple
Tim O'Connor

Attached for your review is a copy of a final (first draft) research report just received from one of our 1991 Small Grant recipients. If you would like to provide comments, please return them to me by Wednesday, June 30.

As you will see, this is basic research, highly academic in character. A "layman's summary" is not provided, so, as it stands, the interest and usefulness of the report for our purposes may be limited.

If we would like John Formby to make a presentation of his work at Park Office Center, a date that he favors is Thursday, June 24. He is interested in attending the Food Stamp Research Conference on June 25, so this date would be convenient for him.

I will schedule a brown-bag seminar presentation for June 24, 12:00 to 1:30 p.m., unless this time and date are not convenient for you. Please let me know right away.

Gary Bickel

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Executive Summary

The Food Stamp Program (FSP) unquestionably has effects on poverty, but due to measurement problems its impact in particular years and across time has been difficult to assess. Poverty has several distinct dimensions including the number of poor, the severity of the income deficiencies and the relative and absolute distribution of income among the poor. Further, the short-run dynamics of income changes imply that some of the poor are only temporarily in poverty and there may be considerable income mobility among those that remain in poverty. The food stamp program almost certainly has effects on each of these aspects of poverty, but use of the official poverty line, Census money income and simple numerical counts of the poor provide no insight into the impact of the FSP.

Substantial progress has been made over the last decade in three distinct areas relating to poverty research, which provide the opportunity to rigorously evaluate the effects of the Food Stamp Program on poverty. These developments furnish researchers with the requisite theoretical foundations, data and tools of analysis to demonstrate the effects of the FSP on all aspects of poverty. This study applies recent developments in the conception and measurement of poverty, improved microdata and new statistical inference procedures to test the effects of the FSP on poverty in the 1980s. To investigate this general question, the research utilizes the theoretical insights of Sen (1976, 1983), the dominance methodology of Foster and Shorrocks (1988), the Census Bureau's improved microdata contained in the noncash benefit and after-tax supplements to the *Annual Demographic File*. It also utilizes recently developed

statistical inference procedures to investigate the effects of the FSP on poverty on the 1980s. The study accepts the effects of direct taxes and other transfers as a given and microdata on before and after food stamp incomes are analyzed to address a number of specific research questions.

The principle findings that emerge from the study are as follows:

- The effectiveness of the FSP at reducing poverty in any given year is sensitive to the poverty line chosen and the poverty measure (headcount or poverty gap) chosen.
- The poorest individuals (those with comprehensive equivalent incomes less than 25 percent of the official poverty line) receive smaller food stamp transfers than any other group below the poverty line for each of the five years considered. This result does not change when economic and social factors that differ across different segments of the poverty population are held constant. However, the result is sensitive to the equivalence scale used.
- A comparison of the headcount reductions due to the FSP across time (1982 vs. 1990) are sensitive to the poverty line chosen. At the official poverty line and above, 1982 dominates 1990, while at three-quarters of the official line and below 1990 dominates 1982.
- In contrast, the poverty gap reductions due to the FSP are larger at each preselected poverty line cut-off in 1990 than in 1982. Thus, the FSP was more effective across time in reducing the income deficiencies of the poor at all poverty lines considered.
- The FSP reduces inequality among the poor, is progressive, among the low income population and leads to only a small degree of "leap-frogging," or re-ranking between needs-adjusted families.
- The measured effectiveness of the FSP is enhanced if we evaluate poverty using a two year accounting period and when we add the imputed value of owner occupied housing to comprehensive income. In contrast, inclusion of the imputed value of medical benefits has no impact on the poverty reducing effects of the FSP.

- Neither participation in the FSP nor the level of food stamp transfers are related to the size of equivalent family incomes.
- The likelihood of participation in the FSP is higher for families that live outside the West, live in rural locations, receive other in-kind transfers, have small children, are nonwhite, female, or disabled. The likelihood of participation is smaller for homeowners, high school graduates and the older the head of the family.
- Equivalent food stamp benefits decline as the number of earners increases, with receipt of other in-kind transfers, when a small child is present, and as the age of the head increases. Equivalent food stamp transfers increase for residences in the Midwest or South, home owners, and high school graduates.

I. INTRODUCTION

The methodology of officially measuring poverty in the United States dates from the 1960s and ignores billions of dollars in government in-kind transfers, including more than \$20 billion distributed in 1992 under the Food Stamp Program (FSP). In an early study, Edgar Browning (1976) underscored the consequences of omitting in-kind transfers in estimating the incomes of the poor. This was followed several years later by statements in Congress about the quality of poverty data.¹ The official poverty statistics also ignore direct taxes, which have substantial effects on the working poor and can affect the non-working poor as well. The presence of in-kind benefits and taxes leads to two difficulties. First, direct taxation of the poor makes the poverty problem more severe than it appears in official statistics, while the presence of in-kind transfers makes it less harsh. Second, in-kind transfers and taxes do not affect the millions of poor families in the same manner; some receive substantial in-kind transfers and pay little or no taxes, while others receive virtually no in-kind benefits but pay significant amounts in taxes, particularly payroll taxes.

The use of the official measurement methodology and resulting poverty statistics creates two additional problems. It is now widely recognized that the official poverty line is arbitrary and a different picture of the effects of a program

1. See U.S. Senate Statement - 1981, "Data Collection and Poverty Level," in Appendix G, U.S. Bureau of the Census, Current Population Reports, Series P-60, No. 164-Rd-1, *Measuring the Effect of Benefits and Taxes on Income and Poverty: 1986* U.S. Government Printing Office, Washington D.C., 1988.

such as the FSP may emerge if alternative poverty lines are considered. Further, given any poverty line, the use of a headcount poverty measure is highly restrictive in that it fails to provide insight into the income deficiencies of the poor and the changes in those deficiencies that result from programs such as the FSP.²

The FSP has unquestionably had effects on poverty, but due to the measurement problems noted above, the exact impact in particular years and across time is difficult to assess. Substantial progress has been made over the last two decades in three distinct areas relating to poverty research, which now provide the opportunity to more effectively evaluate the effects of the FSP on poverty. These developments provide researchers with the requisite theoretical foundations, data, and tools of analysis to go well beyond the restrictive notions of a headcount poverty measure and an arbitrarily fixed "official" poverty line, which are at the heart of empirical and policy related studies of poverty. The new developments are reviewed in detail below, but are briefly discussed here as a preamble to the statement of the objectives of the proposed research. First, the work of Amartya Sen (1976, 1981, 1983), Rueben Saposnik (1981, 1983), Anthony Shorrocks (1983), James Foster (1984) and Foster and Shorrocks (1988, 1989) provide new and fundamental theoretical insights into the basic conception of poverty, its measurement and its

2. Despite serious shortcomings the official poverty statistics have proved useful in assessing long run efforts to reduce poverty. Isabel Sawhill (1988) provides an excellent survey of the literature relating to official measurement issues and difficulties in reducing poverty.

relation to the overall distribution of income.

Parallel to developments in the theoretical foundations of poverty measurement, there have been major improvements in microdata, which are the raw material used in all applied studies of poverty. At the urging of Congress, the U.S. Census Bureau began systematically collecting and reporting the effects of noncash benefits on the incomes of the poor in 1980 and incorporating them into a supplement to the *Annual Demographic File* of the Current Population Survey (March CPS tapes). At approximately the same time, the Census Bureau also began estimating and reporting direct income, payroll and property taxes in a separate supplement to the *Annual Demographic File* of the CPS. Recently, the Census Bureau began the process of merging the estimates of noncash benefit values and after-tax money income estimates for selected years in the 1980s. These merged CPS files provide the most comprehensive microdata available for analyzing poverty from a variety of perspectives.

The merged CPS files, of course, are statistical samples. Estimates of the effects of the FSP and other government programs on poverty and the distribution of income are necessarily subject to sampling errors. A third important development addresses the problem of sampling errors. Charles Beach and Russell Davidson (1983), Beach and James Richmond (1985), John Bishop, John Formby and Paul Thistle (1989), Nanak Kakwani (1990) and Bishop, Formby and Victor Chow (1991b) develop statistical inference procedures that can be applied to the improved Census microdata to make inferences and test hypotheses about various dimensions of

poverty. The new inference procedures complement the recent theoretical developments in the measurement of poverty and exploit the improved microdata that are now available. To date, the new inference procedures have been used principally to study income distribution issues,³ but can be adapted to measure and investigate questions relating to poverty and the effects of the FSP in the 1980s.

This study applies recent developments in the conception and measurement of poverty and improved microdata to investigate the effects of the FSP on poverty in the 1980s. Where appropriate, the research makes use of recently developed statistical inference procedures to rigorously evaluate the effects of the FSP by taking sampling errors into account. Thus, the study seeks to bring together the important developments in theory, improved microdata and inference procedures and hypothesis testing to shed new light on the question of how the FSP has contributed to the amelioration of poverty in the 1980s and 1990s. The research focuses on the following specific questions.

- Given other tax and transfer programs, how has the FSP shifted the distribution of income to affect official headcount poverty measures in the 1980s?
- Given other tax and transfer programs, how has the FSP shifted

3. See, for example, Bishop, Formby and Thistle (1989, 1991a, 1991b), Bishop and Formby (1990), Bishop, Formby and W. James Smith (1991a, 1991b), Bishop, Formby and K. Victor Chow (1991a) and Bishop, Formby and Lester Zeager (1991). These studies use microdata from a variety of sources including Public Use Samples of the Census of Population, the standard March CPS tapes and on-line national survey data of countries participating in the Luxembourg Income Survey. To date, none of the published studies have used the CPS Merge files, CPS noncash benefit files and CPS after-tax money income files that will be analyzed in the study of the effects of the FSP on poverty in the 1980's.

the distribution of income to affect the gap between the official poverty line and the after-tax and after-transfer income distribution among the poor?

- How do alternative specifications of the poverty line influence the findings concerning the effects of the FSP on headcount measures? In particular, do alternative poverty lines qualitatively change the conclusions about the effects of the FSP on poverty in the 1980s.
- Does application of Foster and Shorrocks' poverty dominance method permit unambiguous conclusions concerning the effectiveness of the FSP in reducing poverty in the 1980s? In particular, do food stamp transfers in the most recent year (marginally) dominate earlier years in terms of poverty reduction? Are the dominance results statistically robust?
- How does the receipt of food stamp transfers (versus no FSP transfers) affect the distribution of income among the poor? Are food stamp transfers progressive? Has the transfer progressivity increased over time? How severe are the rerankings among the poor that are induced by food stamp transfers?
- Are results relating to the reduction in poverty sensitive to the time frame studied, the particular definition of income used, or to the equivalence scale employed?
- If we correct for differences in demographic, social and economic factors are the families in the lower ranges of the income distribution more or less likely to participate in the FSP? Do such families receive larger food stamp transfers?

The remainder of this report is organized as follows.

Section II discusses relevant theoretical issues in poverty measurement, and the statistical inference procedures used to test hypotheses. Section II also provides details about the research methodology as well as the rationale and justification for using it to examine the effects of the FSP on poverty in the decade of the 1980s. Section III describes the tax and in-kind transfer augmented CPS microdata employed in this study. Section III also discusses how the CPS data are used to identify income receiving units and the construction of comprehensive measures of

income. Section IV presents the empirical results of the effect of the Food Stamp Program on poverty in the 1980s. The final section summarizes the major findings of the research, discusses the limitations of the study, and suggests areas for further research.

II. RECENT DEVELOPMENTS IN THE MEASUREMENT OF POVERTY

A. *Some Conceptual Difficulties in Measuring Poverty*

Sen's pathfinding contributions have led to a serious reconsideration of how poverty is conceived and measured. Sen's work (1976, 1981, 1983) is best known for its fundamental challenge to the official measurement methodology, which simply counts the poor below a designated poverty line. A basic problem with headcount poverty measures is that they fail to reflect the intensity or severity of poverty. An implication of this failure for the FSP is that the standard measure of poverty considers only the number of poor that are moved above the poverty line, while ignoring the FSP's effects on the intensity of poverty. This difficulty can be overcome by using an income gap measure of poverty. A poverty gap measures the income deficiencies of the poor by calculating the total income required to raise all of the poor to the official poverty line. But Sen is just as critical of income gap measures of poverty as he is of headcount measures. The difficulty with both approaches is that they fail to take into account the distribution of income⁴ among the poor, which

4. In this paper we use the term income distribution to mean an ordered vector of incomes.

Sen and many other observers believe is important. The shortcomings of the headcount and poverty gap indexes has motivated Sen and other researchers to seek a better measure of poverty.

Sen accepts an established poverty line as a starting point and asks the basic question: what properties should a measure of poverty satisfy? Three axioms are advanced to address this issue, which reveal much about Sen's insights into the nature of poverty in modern nations. As its name suggests, the focus axiom concentrates attention on those below the poverty line: it asserts that once the line is established, only the incomes of those below the line are to be considered in measuring the overall level of poverty. Both headcount and income gap poverty measures are *necessarily* consistent with the focus axiom. Sen's second axiom is referred to as the monotonicity axiom: if income is transferred from a poor to a nonpoor person monotonicity implies that the measure of poverty must *necessarily* rise. The most important effect of the monotonicity axiom is that it flatly rules out headcount measures of the sort which the official U.S. poverty measure is the leading genus. In contrast to headcount measures, income gap measures of poverty are consistent with the monotonicity axiom.

An important aspect of Sen's work on poverty incorporates distributional considerations into the measurement of poverty. To accomplish this Sen advances the weak transfer axiom, which asserts that the measure of poverty should increase if income is redistributed away from the most intensely poor to the relatively

more affluent poor. Neither headcount nor income gap poverty measures are necessarily consistent with the weak transfer axiom. The implication of this for the FSP is that even when food stamp transfers reduce headcount and income gap poverty measures, as they most surely do, in combination with other government policies (e.g., increases in payroll taxes) there may be adverse income distribution effects among the poor which violate the weak transfer axiom.

The most controversial aspect of Sen's work on poverty is the particular index he advances to measure poverty. The heart of his approach involves a ranking of the poor and the concept of relative deprivation. Sen's measure assigns weights to the individual poverty gaps according to the rank order of the poor below the poverty line, with the most intensely poor receiving the greatest weight. While consistent with the three axioms the weighting scheme can affect the conclusion as to whether poverty increases when income is redistributed among the poor. Thus, the combined effect of tax and transfer policies affecting the poor could raise the aggregate income of the poor, which would seem to reduce poverty, but redistributions among the poor could result in Sen's index showing a rise in poverty rather than a decline. Two other difficulties with Sen's measure are worth noting. As Foster (1984, p. 222) emphasizes, Sen's measure is by no means the only summary index of poverty that is consistent with the three axioms nor is it necessarily the best measure. Thus, acceptance of the axioms in no way implies agreement with Sen's relative deprivation approach to measuring poverty. Second,

Sen's measure is based upon the acceptance of an arbitrary poverty line and the index can give counter-intuitive results when variable poverty lines are considered.

Sen's work triggered a number of major papers relating to poverty measurement, with numerous summary measures proposed as alternatives to headcount, income gap and Sen's own index. Foster (1984) provides an excellent survey of this literature, concluding that no *single* poverty index captures all relevant aspects of poverty and the choice among summary measures "...involves a certain degree of arbitrariness" (1984 p.242).

B. The Dominance Approach to Evaluating Poverty

The difficulties with Sen's measure and especially the problem of choosing among the multiplicity of competing poverty indexes has led to a major new development in the evaluation of poverty, which relies upon the dominance method for ranking income distributions. The dominance approach avoids indexes by directly considering the distributions functions themselves. The early work relating to dominance analyzed entire income distributions and has only recently begun to be applied to the low income segment of the distribution to analyze the problem of poverty. We make extensive use of the dominance analysis in evaluating the effects of the FSP on poverty. We begin by briefly summarizing the methodology. We point out that a more complete survey of dominance and income distributions in general is provided by Bishop, Formby and Thistle (1989) and Bishop and Formby (1993). Bishop, Formby and Smith (1993) provide a recent application to poverty rankings across countries.

Atkinson (1970) made the original contribution concerning the use of the dominance method for ranking income distributions. He showed that, for distributions with equal means, strong inferences can be made about comparative states of economic well-being when Lorenz curves do not intersect. Atkinson demonstrated that with equal means, Lorenz dominance implies second order stochastic dominance, a potent criterion for ranking distributions that carries powerful welfare implications. The Atkinson theorem and its elegant simplicity gave rise to additional studies having important implications for the measurement of poverty.

Working independently, Shorrocks (1983) and Saposnik (1981, 1983) demonstrate that the original Atkinson theorem can be extended to distributions with different levels of mean income. Shorrocks shows this can be accomplished by merely comparing Lorenz curves scaled up by the level of mean incomes, which he refers to as "generalized Lorenz (GL) curves." The GL curve, like the ordinary Lorenz curve, incorporates a preference for equality, but unlike the Lorenz curve, it also incorporates an efficiency preference. It is now widely recognized that GL dominance is analytically equivalent to second order stochastic dominance (SSD). Saposnik's approach to the problem is more direct, but closely related. He applies first order stochastic dominance (FSD) techniques directly to income distributions. The procedure involves comparing absolute incomes in ranked (ordered) positions in the income distribution and is referred to by Saposnik as "rank dominance." As now widely recognized, FSD

implies SSD and as a result, rank dominance implies GL dominance. Because it requires fewer restrictive assumptions about the relation of overall well-being to the income distribution FSD is more general than SSD, but it has the potential disadvantage of not being able to order as many distributions.

To explain the relationship between dominance of one income distribution over another and poverty we make a standard assumption and follow Atkinson (1970) by letting the relationship between the distribution of income and standard of living be summarized in a social welfare or social evaluation function, which represents society's ethical judgments concerning income distributions. We begin by summarizing first order (rank) dominance and then consider second order (generalized Lorenz) dominance. We then show how these very general approaches to ranking entire income distributions can be used to evaluate the effects of food stamp transfers on poverty.

Rank or First Order Dominance. First order stochastic dominance (FSD) is underpinned by the strong Pareto principle and anonymity (symmetry), two assumptions having a wide degree of acceptance in income distribution and poverty studies. In addition, we invoke the population principle [(Dalton, (1920), Dasgupta, Sen and Starrett, (1973) and Sen (1976)] to compare distributions having different size populations. Together these assumptions imply that the statistical cumulative distribution function (cdf) for income contains sufficient information for ranking alternative social states. Formally, let F denote the income cdf. The inverse distribution function or quantile

function, $X(p) := \inf \{x: F(x) \geq p\}$, $p \in [0,1]$, arranges recipients' incomes in increasing order.

We denote the class of anonymous, increasing welfare functions as W_p . Saposnik (1981, 1983) provides the following theorem on rank dominance:

THEOREM 1: $X >_R Y$ iff $w(X) > w(Y)$ for all $w \in W_p$.

Thus distribution X dominates distribution Y iff $X(p) \geq Y(p)$ for all $p \in [0,1]$. If for all $p \in [0,1]$, $X(p) = Y(p)$, then X and Y have the same income distribution and standard of living. If $X(p) > Y(p)$ for some p , and $X(p) < Y(p)$ for some p (i.e., the quantile functions cross), the distributions are noncomparable and cannot be ordered using the rank dominance criterion.

GL (Second Order) Dominance. As with rank dominance, the income distribution (cdf) contains all the information necessary to apply the GL criterion. Also like rank dominance, it is more convenient to define the GL function in terms of the inverse function, F^{-1} . Adapting the basic notion of a Lorenz curve, the GL curve can be written as

$$G_X(p) = \int_0^p F^{-1}(x) dx = \mu_X L_X(p),$$

where $L_X(p)$ is the ordinary Lorenz ordinate and $G_X(1) = \mu_X$. The GL criterion requires that the class of admissible welfare functions be restricted to only those that are equality-prefering. Dasgupta, Sen and Starrett (1973) demonstrate that this amounts to assuming that the welfare function is S-concave. We denote the class of anonymous, increasing, and S-concave

welfare functions, as W_E . Shorrocks (1983) demonstrates the relationship between GL dominance, W_E , and second order stochastic dominance with the following theorem on GL dominance:

THEOREM 2: $X >_{GL} Y$ iff $w(X) > w(Y)$ for all $w \in W_E$.

Income vector X generalized Lorenz dominates Y , denoted $X >_{GL} Y$, if, and only if, $G_X(p) \geq G_Y(p)$ for all $p \in I$, with at least one strict inequality at some p . Like ordinary Lorenz curves the GL criterion provides only a partial ordering because crossing generalized Lorenz curves cannot be ranked. Thus, GL curves can be compared in essentially the same manner as ordinary Lorenz curves.

Stochastic Dominance and Poverty. In a seminal contribution, Foster and Shorrocks (1988) demonstrate the connection of stochastic dominance rankings and poverty. They provide a corollary to THEOREM 1 linking rank dominance (FSD) to the headcount poverty concept. To see this relationship let $H(z)$ be the proportion of the population lying at or below the poverty line, z . Specifically, $H(X;z) = q(x;z)/n(x)$ where $q(x;z)$ is the number of incomes in X that do not exceed z and $n(x)$ is the number of persons in the population:

COROLLARY 1: $X \geq_{FSD} Y$ iff $X \geq_{H(z)} Y$ for all z .

The corollary implies that an unambiguous decline in headcount poverty is sufficient for rank dominance. Conversely, if distribution X rank dominates distribution Y , then headcount poverty in X cannot exceed that of Y , regardless of the income

cutoff, z , used. Thus, truncating the distribution above any arbitrary poverty line, z , and testing for first order dominance on the truncated distribution provides a more general headcount poverty ordering over a wide range of alternative poverty lines.

Figure 1 illustrates the relationship between first order dominance and headcount poverty. The data used to construct Figure 1 are from the 1990 CPS merge file and are discussed in detail in Sections III and IV below. We use actual data in this Section merely to illustrate the application of Foster and Shorrocks' poverty Corollary to the measurement of the effects of food stamps on income distributions of the low income population. Figure 1a depicts two cumulative distribution functions denoted as Before-FS and After-FS, which show comprehensive incomes before and after food stamp transfers for a sample consisting of the entire low income population, which consists of all incomes at or below 150 percent of the official poverty line. Our objective is to analyze poverty at different points in the income distribution, so we focus on fractiles of the income distribution that correspond to proportions of the official poverty line. Thus, a fraction of the poverty line appears on the vertical axis of Figure 1, with values ranging from 0.25 to 1.5 of the official poverty line.

[Insert Figure 1 about here]

To interpret Figure 1 consider any equivalent per capita income, m , that corresponds to a poverty line z_m , which (like other poverty lines) is expressed as a fraction of the official poverty line *in the Before-FS income distribution*. In Figure 1a

Figure 1a

First Degree (Headcount) Dominance, 1990

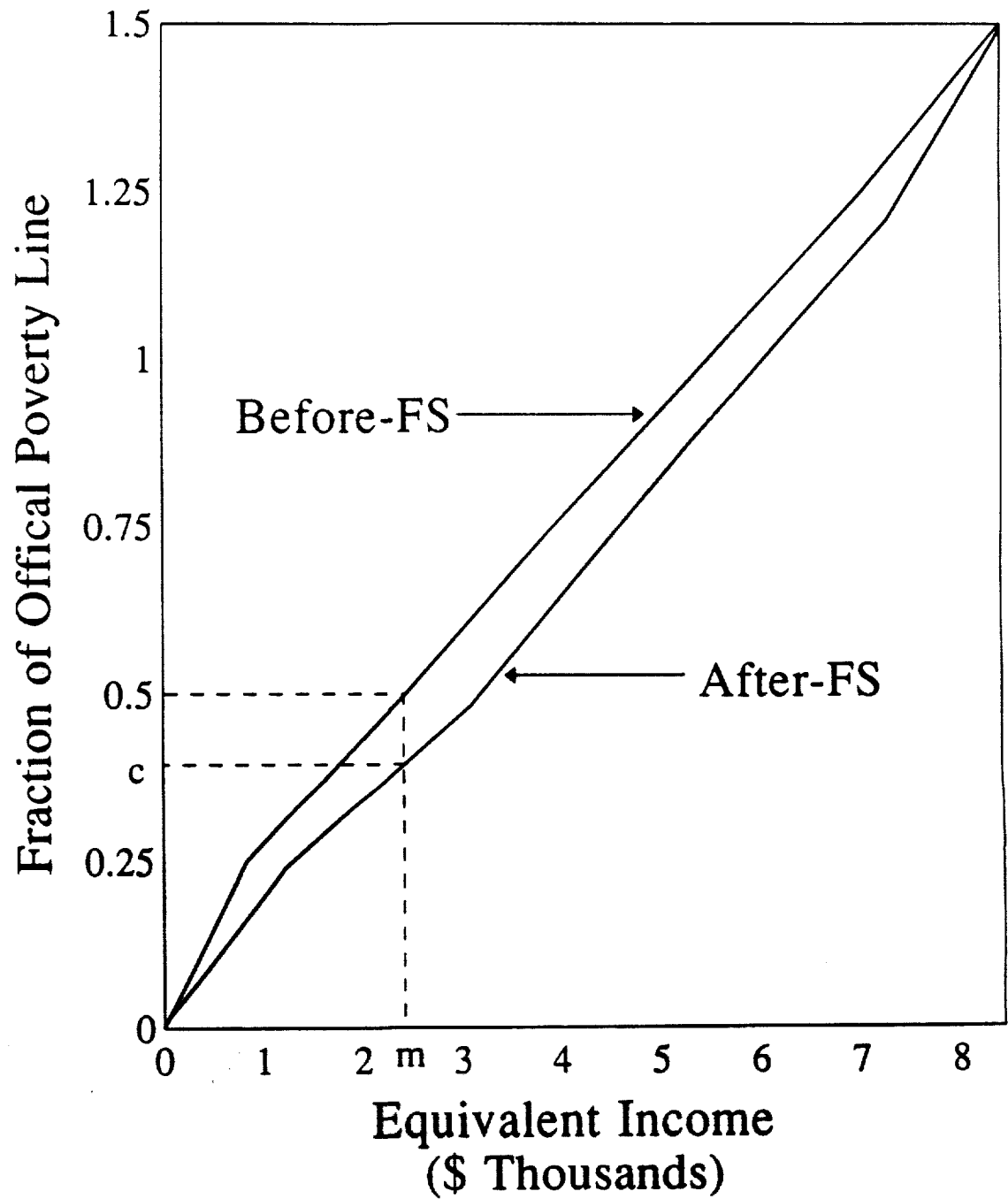
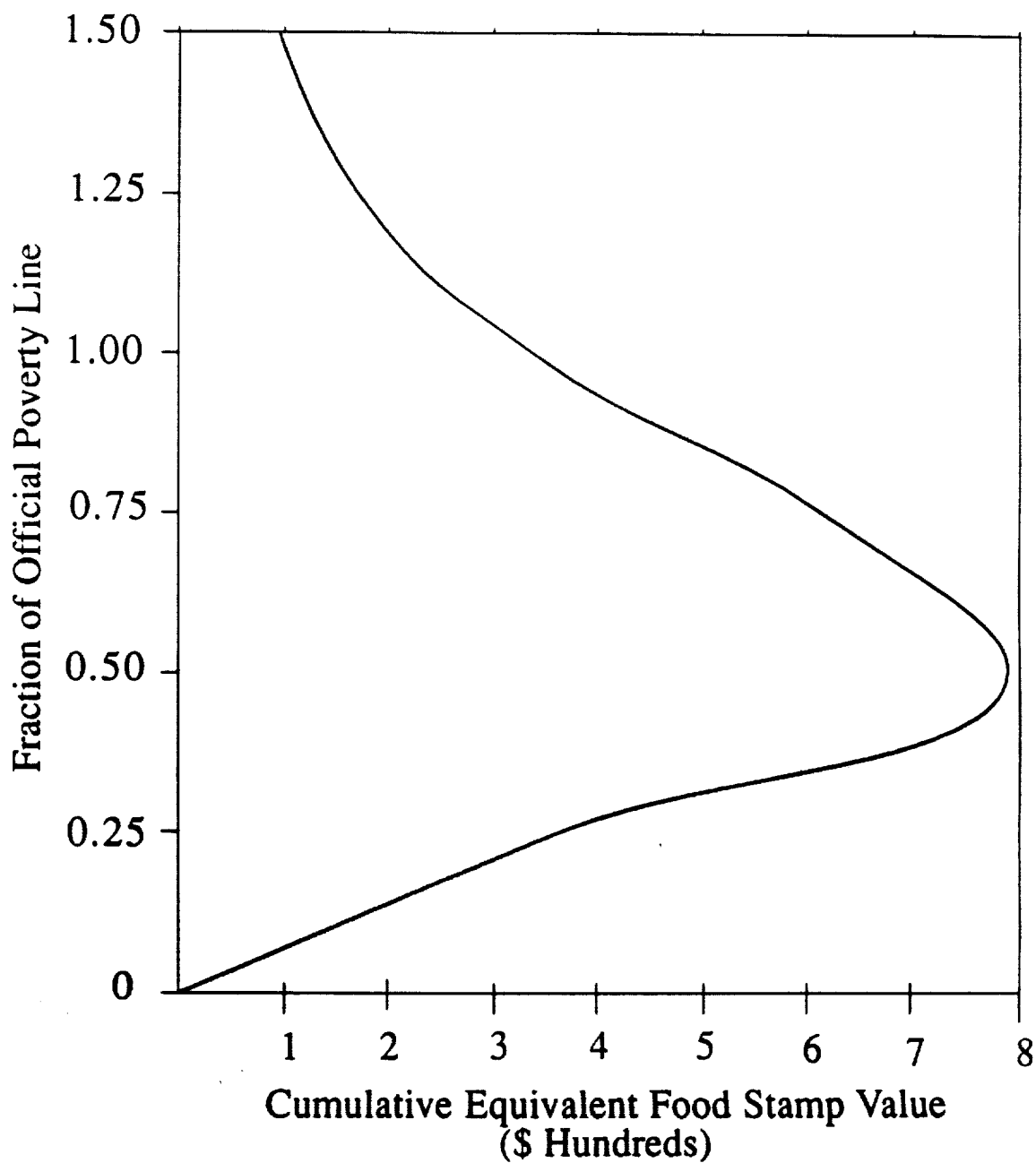


Figure 1b

Food Stamp Transfers, Ordered by
Before - FS Income, 1990



we choose m such that we are at a poverty line equal to one-half the official poverty line. Thus, at m the ordinate of the Before-FS distribution function, z_m , is equal to .5. Adding food stamp transfers to Before-FS incomes raises the income of recipients and reduces the number of poor. Thus, the After-FS distribution is expected to lie to the right of Before-FS distribution. Consequently, the ordinate of the After-FS distribution function at m , denoted by c , is always expected to be less than z_m , i.e., $z_m - c > 0$.

In Figure 1a, the reduction in headcount poverty accompanying food stamp transfers is indicated by the vertical distance between the Before-FS and After-FS distribution functions. At m , this is $z_m - c$. Foster and Shorrocks' Corollary 1 implies that if the After-FS distribution lies everywhere to the right of the Before-FS distribution, then food stamps unambiguously reduce headcount poverty, regardless of the poverty line chosen. The horizontal deviations of the After-FS distribution away from the Before-FS distribution also have an interpretation: they represent the value of food stamp transfers at particular poverty lines. The value of the food stamps at each poverty line is plotted in Figure 1b. Curves like the one in Figure 1b are used to evaluate the effects of the FSP on headcount poverty across time. Of course, Figure 1b simply represents the horizontal deviations of the Before-FS and After-FS distributions depicted in Figure 1a.

Foster and Shorrocks (1988) also provide a corollary to THEOREM 2 which connects second order dominance (the GL criterion)

to poverty gap measures of the income deficiencies of the poor. A poverty gap is defined as the weighted sum of the income shortfalls of the poor, or,

$$P(m; z) = \frac{1}{n(m)z} \sum_{i=1}^r (m_i),$$

where z is the poverty line income and r is its corresponding order statistic. For any given z , the poverty gap criterion is $m > P(z) \ Y$, iff, $(1/n) \sum x_i > (1/n) \sum y_i$, for all i up to r .

COROLLARY 2: $X \geq_{SSD} Y$ iff $X \geq_{P(z)} Y$ for all z .

Corollary 2 implies that an unambiguous decline in the poverty gap is sufficient for second order dominance. Conversely, if distribution X second order dominates distribution Y , then the poverty gap in X cannot exceed the comparable poverty in Y , regardless of the income cutoff, z , used. Thus, truncating the distribution above any arbitrary poverty line, z , and testing for second order dominance on the truncated distribution provides a more general poverty gap ordering over a wide range of alternative poverty lines.

Figure 2 illustrates the relationship between second order dominance and poverty gaps. As in Figure 1, the fraction of the official poverty line appears on the vertical axis. However, in Figure 2 the *cumulative* adult equivalent per capita income appears on the horizontal axis. For any equivalent per capita income, m , the reduction in poverty gap attributable to food stamp transfers is indicated by the difference between the cumulative Before-FS and *cumulative* After-FS income curves. In

order statistic. For any given z , the poverty gap criterion is $m > P(z) Y$, iff, $(1/n) \sum x_i > (1/n) \sum y_i$, for all i up to r .

COROLLARY 2: $X \geq_{SSD} Y$ iff $X \geq_{P(z)} Y$ for all z .

Corollary 2 implies that an unambiguous decline in the poverty gap is sufficient for second order dominance. Conversely, if distribution X second order dominates distribution Y , then the poverty gap in X cannot exceed the comparable poverty in Y , regardless of the income cutoff, z , used. Thus, truncating the distribution above any arbitrary poverty line, z , and testing for second order dominance on the truncated distribution provides a more general poverty gap ordering over a wide range of alternative poverty lines.

Figure 2 illustrates the relationship between second order dominance and poverty gaps. As in Figure 1, the fraction of the official poverty line appears on the vertical axis. However, in Figure 2 the *cumulative* adult equivalent per capita income appears on the horizontal axis. For any equivalent per capita income, m , the reduction in poverty gap attributable to food stamp transfers is indicated by the difference between the *cumulative Before-FS* and *cumulative After-FS* income curves. In Figure 2a, m is set equal to the cumulative income corresponding to one-half of the official poverty line. The difference in the ordinate of the *cumulative After-FS* income curve is indicative of the impact of food stamp transfers on the poverty gap at m . Foster and Shorrocks' Corollary 2 implies that if the *cumulative After-FS* income curve lies everywhere to the right of the

cumulative Before-FS curve, then there is an unambiguous reduction in the poverty gap, regardless of the poverty line chosen. As in Figure 1, the horizontal deviations of the After-FS cumulative income curve and the Before-FS cumulative income curve reflect the cumulative value of food stamps. These are plotted in Figure 2b. In applying Foster and Shorrocks' second order dominance Corollary to evaluate changes in the effect of the FSP on poverty gaps across time, we compare differences in food stamp distributions like those depicted in Figure 2b.

[Insert Figure 2 about here]

Finally, it is important to recall that first order dominance necessarily implies second order dominance. As a consequence, headcount poverty dominance implies poverty gap dominance, but the converse does not hold. Thus, it is possible to conclude that there is no unambiguous headcount ranking of poverty, but the distribution of income in one low income population dominates another in the sense that it has smaller poverty gaps at every conceivable poverty line. The implications of this for the FSP can be summarized as follows: Across time the effects of the FSP program on headcount poverty may be sensitive to the specific poverty line considered (i.e., a crossing occurs), while the effects on the poverty gap may be unambiguous (i.e., second order dominance exists).

Marginal Poverty Dominance. Foster and Shorrocks' corollaries to the first and second order theorems allow us to apply the dominance method to ordinally evaluate the impact of the FSP on poverty at different levels of income corresponding to

Figure 2a

Second Degree (Poverty Gap) Dominance, 1990

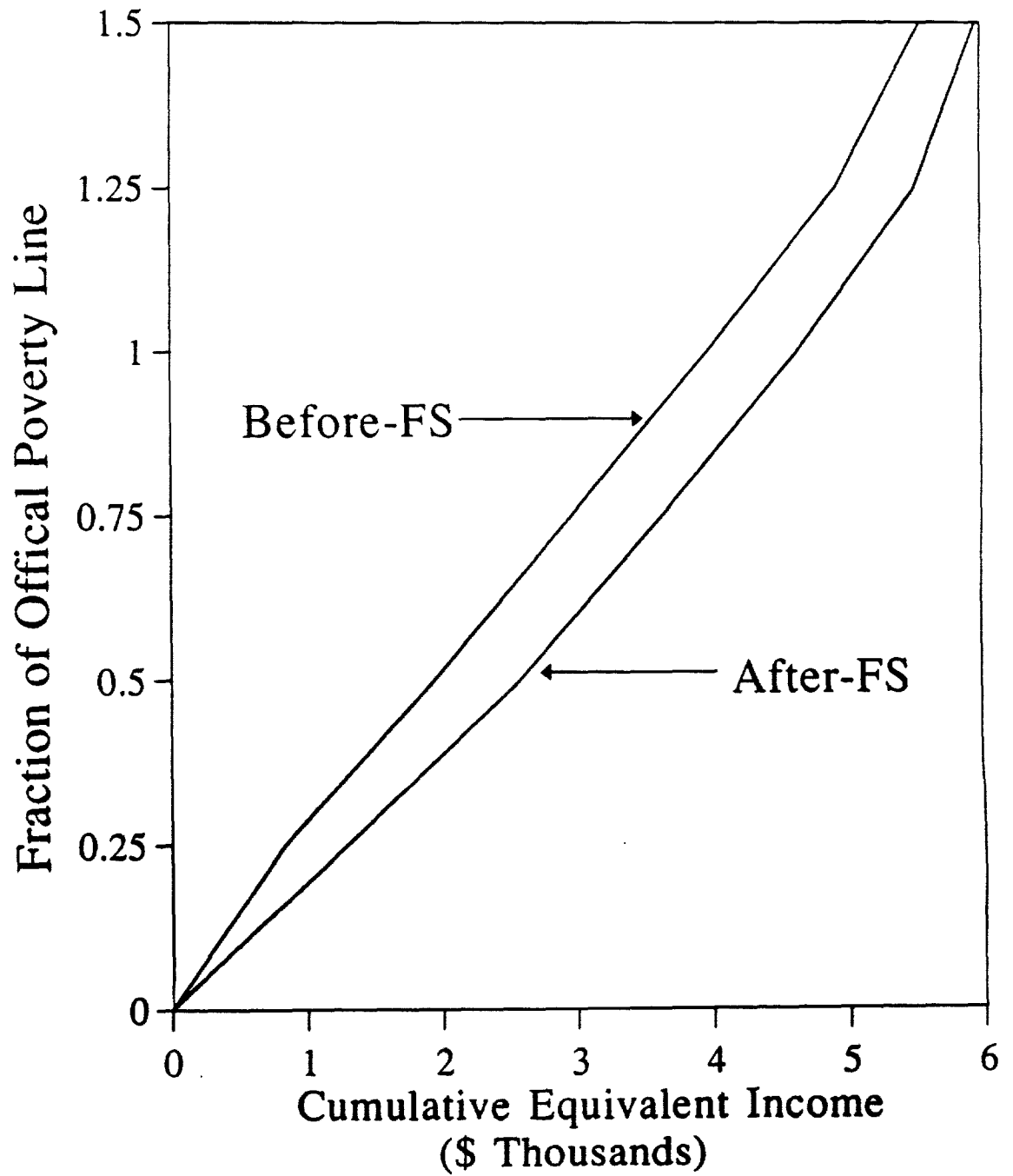
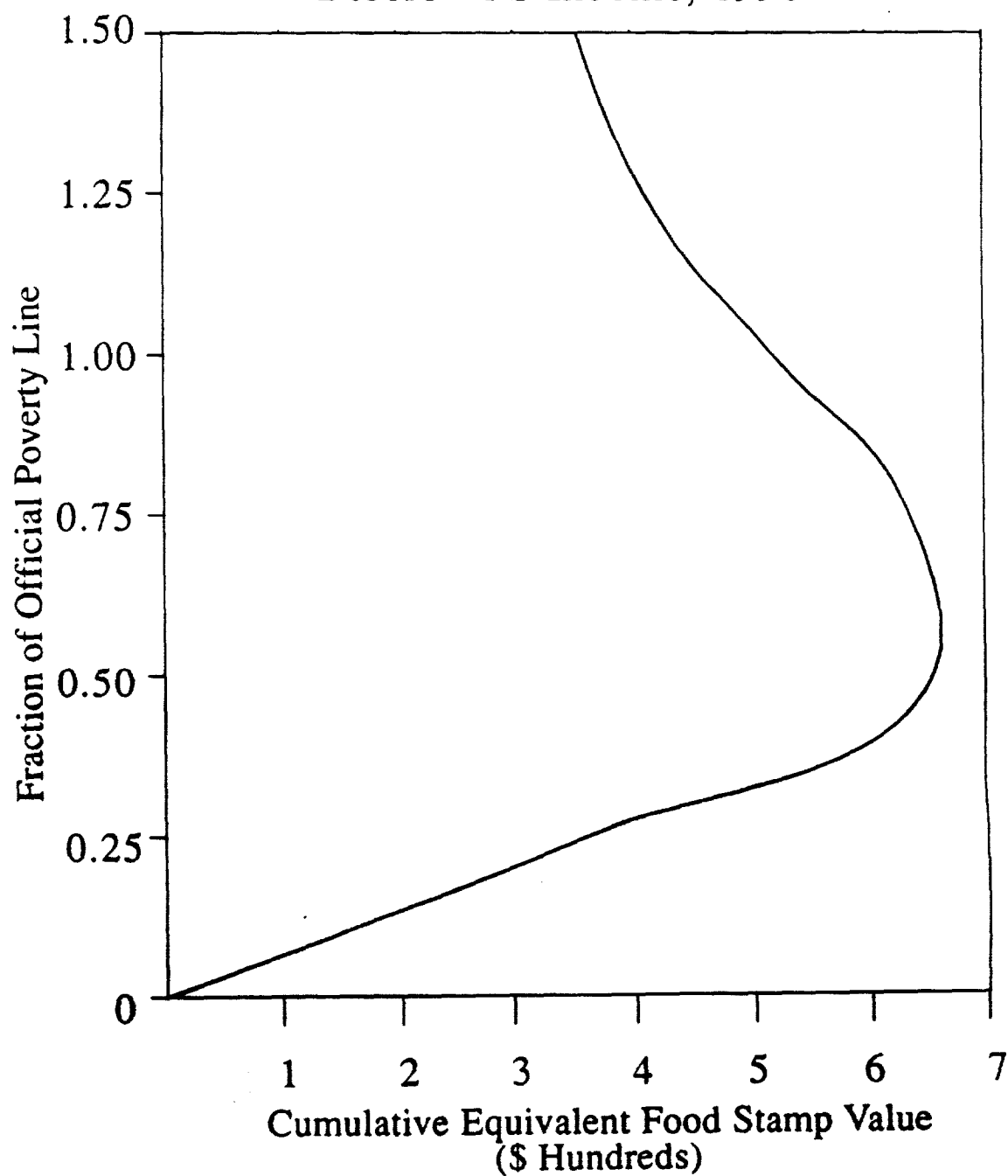


Figure 2b

Cumulative Food Stamp Transfers, Ordered by
Before - FS Income, 1990



alternative poverty lines. More importantly, however, the Foster-Shorrocks approach allows us to evaluate the *marginal* redistributive effects of food stamp transfers on the income distribution of the low income population. We refer to this as *marginal* poverty dominance and use it to address the following question:

- Has the FSP program become more or less effective over time in reducing headcount poverty?

To make comparisons of the effectiveness of the FSP in reducing poverty requires that we compare the area between the Before-FS and After-FS curves at various preselected poverty lines. Equivalently, we can compare the size of the FS transfer (ordered by pre-transfer income) at each poverty line. If FS transfers of the sort depicted in Figure 1b are larger at each poverty line in year 1 than in year 2, then we conclude that the FSP was unambiguously more effective in reducing headcount poverty in year 1 relative to year 2. Similarly, we make comparisons of the effectiveness of the FSP in reducing poverty gaps by comparing the *cumulative* mean FS transfers in each year using constructs like those shown in Figure 2b. The analysis of *cumulative* mean FS transfers allows us to address the following question:

- Has the FSP program become more or less effective over time in reducing income shortfalls and the poverty gaps?

Thus, in evaluating marginal poverty dominance, we apply Foster and Shorrocks' headcount and poverty gap corollaries to ordinally evaluate the redistributive effects of the FSP at alternative poverty lines across time.

C. Statistical Inference

Inference procedures can be applied to indexes of poverty such as headcount ratios, poverty gap measures and weighted indexes like the one advanced by Sen. In a seminal contribution, Beach and Davidson (1983) provide asymptotically distribution-free inference procedures for testing for differences in Lorenz curves. Bishop, Formby, and Thistle (1989) show that the Beach-Davidson test can be easily extended to first and second order dominance.⁵ One important limitation of the Beach-Davidson tests is that they require independent samples. This is particularly severe in the study of food stamps because the Before-FS and After-FS incomes are clearly dependent. Bishop, Chow and Formby (1991b) recognize the restrictions imposed by the independence assumption in analyzing the marginal effect of tax and transfers and propose a "matched-pair" (dependent samples) test that overcomes this important difficulty.

The Bishop, Chow, and Formby test procedure can be used to address both ordinary dominance and marginal dominance. For any type of dominance tests there are three possible results. First, there may be no significant difference between the size of the food stamp transfers at any of the preselected poverty lines. Second, a dominance relation can exist where the size of the food stamp transfer is everywhere greater (or at least greater at some

5. The statistical inference procedures with independent samples are based on the work of Beach and Davidson (1983) with extensions by Beach and Richmond (1985), Beach and Kaliski (1986), Bishop, Formby and Thistle (1989), and Kakwani (1990).

poverty lines and not smaller at other poverty lines) in one of the years. Third, food stamp transfers in one year can be larger at some poverty lines and smaller at other poverty lines. In this case, it is not possible to draw unambiguous conclusions concerning the comparative effectiveness of the FSP in reducing headcount poverty across time. Stated differently, this third possibility means that the results are sensitive to where the poverty line is drawn and no general dominance relation exists. A finding of an ambiguous first order (headcount) comparison suggests that we apply second order (poverty gap) dominance. Section IV.B below provides a fuller discussion of statistical inference with ordinary and marginal stochastic dominance.

III. DATA SOURCES, INCOME DEFINITIONS, AND RECIPIENT UNITS

This section discusses the transformations of the CPS data and the samples of the low income population which are used in analyzing the effects of the food stamp program on poverty. One of the unique features of the research is that the basic income measure includes both taxes and in-kind transfers, which makes it possible to test for the sensitivity of the results to different specifications of the income measure.⁶ We first discuss the basic data source, the Current Population Survey, augmented by estimates of noncash transfers and direct taxes. Next, we discuss our use of the term "comprehensive income" and identify its components. Finally, we describe the income recipient units

6. Our sensitivity results (Section IV.D) show the importance of using a broad income definition when evaluating the effects of policy initiatives on poverty.

and equivalent scales used in this study.

A. The CPS Microdata

Beginning in March 1980, the Census Bureau began augmenting the standard Current Population Survey to produce a new microdata file *CPS: Estimates of Noncash Benefits* for calendar year 1979. The CPS Noncash Benefit tapes contain detailed microdata on food stamps and other in-kind transfer programs as well as all the information in the standard *CPS Annual Demographic File*.⁷ The Noncash Benefit tapes are available for calendar year 1979 and calendar years 1981-1985. Beginning in 1981 the Census Bureau also began augmenting the standard *CPS Annual Demographic File* to produce a new microdata file, the *CPS After-Tax Money Income Estimates*, which contain micro estimates of direct taxes including Federal income taxes, state and local income taxes, payroll and property taxes as well as all other information in the standard *CPS Annual Demographic Files*. The After-Tax money income tapes are available for calendar years 1980-1986. Finally, the Census Bureau has merged some of the annual noncash benefit and after-tax files to create CPS Merge files for calendar years 1987-1990. With one exception (medical benefits), the Merge files provide consistent measures of in-kind and after-tax incomes.⁸ In this report, we use data from augmented CPS

7. The March CPS survey for a particular year, say 1991, contains the *Annual Demographic File*. Income statistics are for the previous calendar year (1990), while labor force and unemployment data are for the survey month (March 1991). Therefore, the same data set can be referred to as CPS 1991 or calendar year 1990. We use both descriptions in referring to the data below.

8. There was an important change in the valuation of medicare and medicaid in-kind benefits. For the period 1982-1986 the in-kind benefits of medicaid services were estimated to be the mean value for a risk class. Analysis revealed that this valuation procedure seriously distorted

tapes for calendar years 1979, 1980, 1982, 1983, 1985, 1989, and 1990.

One additional piece of information about the CPS microdata is important to a thorough understanding of the data used in this study. Each CPS survey contains an overlap in the sample such that across any two years about one-half of the total households appear in successive surveys. We take advantage of this overlap in two ways. First, as discussed below we combine the 1979 and 1980 overlapping samples to create a dataset for 1979 that is comparable to later years. Second, for the samples studied after 1980 we use the overlap in successive CPS surveys to create a two year "panel" that allows us to examine the impact of the FSP on those families that were "poor" in both years. A more accurate measure of permanent income excludes transitory poverty and provides additional insight into the effects of food stamps.

To explain the data selection process for each year, we begin with the latest year, CPS 1991 (calendar year 1990). We use the Merge file to create three sub-samples. The first sub-sample, which we denote as Type 1, contains all families and unrelated individuals with Orshansky-adjusted Census money incomes of less than or equal to 150 percent of the official poverty line (10,933 families). The Type 1 sample is the largest sample drawn and is used to evaluate the factors determining program participation and benefits received. From the Type 1 sample, we draw a Type 2 sub-sample which contains all families

comparisons of comprehensive income to the official poverty line. Merge files for 1987-1989 use an alternative procedure, referred to as the fungible value approach.

that were in the sample in both CPS 1990 and CPS 1991 and included those with CPS 1991 Census money incomes no more than 150 percent of the official poverty line (5,238 families). The Type 2 sub-sample is further reduced to create a Type 3 sub-sample containing incomes for a single year of those families that were "poor" in both years (3,103 families). The Type 2 and Type 3 sub-samples allow us to compare the results for a single year to a two year panel dataset. Extending the accounting period for income from one year to two allows us to measure the short run dynamics of poverty and program participation. In addition to creating a two year panel containing CPS 1991 and CPS 1990 incomes, the Merge file was used to create a Type 2 sample consisting of families in both CPS 1990 and CPS 1991 who were poor in CPS 1990 (4,934 families). In this sub-sample, no restrictions are placed on the size of the CPS 1991 incomes.

Merge files are not available for the calendar years prior to 1988 so we construct equivalent data files by merging the CPS Noncash Files with the CPS After-Tax files. For CPS 1986, we create a Type 1 "merge file" of approximately 13,000 families. For CPS 1983, Type 2 (5,676) and Type 3 files (3,638 families) are created using the same procedures. The Type 3 file is restricted to a sub-sample consisting of those families that were poor (Census money incomes no more than 150 percent of the official poverty line) in both CPS 1983 and 1984.

As noted above, the earliest Noncash Benefit tape is for calendar year 1979, while the earliest After-Tax tape is for calendar 1980. To observe and measure the effects of food stamps

on poverty at the earliest possible point in time, we exploit the sample overlap in the 1979 and 1980 surveys to create a calendar year 1979 (CPS 1980) data set that is comparable to later years. To accomplish this, we first restrict the sample to those families that were a part of March surveys in both years. We then used Census money incomes and imputed in-kind transfers from the CPS 1980 Noncash tape and estimate tax rates for the same families using the CPS 1981 After-Tax tape. Next, we deleted all observations whose CPS 1981 Census money income differs by more than two standard deviations from the overall mean from the CPS 1980 income. We then applied the CPS 1981 family-specific average tax rate to the CPS 1980 incomes to impute direct taxes. The resulting sample contains 4,794 families and the estimates of income are comparable to later years.

B. Adult Equivalent Per Capita Comprehensive Income

The basic income definition and recipient unit used in this study is adult equivalent per capita comprehensive income. Census money income is used as the starting point in the construction of comprehensive income. The standard Census measure of money income includes market incomes plus public and private cash transfers. To obtain comprehensive income, three non-food-stamp imputed (market values) of in-kind transfers (energy, school lunches, and housing) are added; state and federal income taxes and the employee portion of payroll taxes are subtracted; and the value of the earned income tax credit is added. Due to the changes over time in the imputation procedure the imputed value of medical benefits are not included in

comprehensive income. Also, the imputed value of owner occupied housing only became available in CPS 1990 and is not included in comprehensive income. Thus, our measure of comprehensive income is one that is comparable across the time period studied and includes all income sources available for 1982 and 1990 except food stamps. We exclude the market value of food stamps from comprehensive income because the objective of the research is to determine the marginal effect of food stamp transfers on this broad definition of income.

We measure incomes before and after food stamp transfers as micro observations of Before-FS and After-FS incomes are at the heart of our analysis. We note a potential difficulty with our comprehensive measure of Before-FS income: it excludes measures of medical benefits and the imputed values of owner occupied housing. Since reliable estimates of these values are available for 1990, Section IV.D below provides a sensitivity analysis of some of our major findings to including both medical benefits and the imputed rental value of owner occupied houses.

We take either the family or unrelated individual as our primary income recipient unit. The Census Bureau defines a family in three ways: primary family, related subfamily, or unrelated subfamily. In this study we collapse the related subfamilies into the primary family. To convert the incomes to adult equivalents, official Orshansky scales are used. Appendix A describes the official U.S. equivalent scale in detail. The choice of equivalence scale is important and Section IV.D provides some comparisons using alternative equivalence scales.

Finally, we weight the incomes by the number of persons in the family and convert all incomes to 1990 dollars using the CPI-X.⁹ The 1990 official poverty line for a nonelderly single adult is \$6257.

IV. FOOD STAMPS AND POVERTY IN THE 1980s

This section discusses our findings relating to specific research questions concerning the effects of food stamp transfers on poverty in the 1980s. We begin by providing summary data on incomes, food stamp transfers, and the distribution of the poor at alternative poverty lines at five points in time during the 1979-1990 period. Table 1 provides the overall mean of the entire truncated income distribution and the cumulative means of the Before-FS income and food stamp transfers at alternative poverty lines. We consider six alternative poverty lines, ranging from one-quarter to 150 percent of the official poverty line. The incomes and FS transfers are ordered by Before-FS income, inflated to 1990 dollars using the CPI-X, converted to adult equivalents using the Orshansky scales, and weighted by persons. Surprisingly, food stamp transfers are apparently not strongly related to income in any year. More importantly, in all cases the persons below 0.25 of the official poverty line receive smaller FS transfers than those below 0.50; i.e., the poorest of the poor receive smaller food stamp transfers than the poor who ranked higher in the income distribution. To further investigate

9. Section IV.E is the exception to this rule in that it uses family weighted data.

this result, Section IV.E examines the relationship of income to FSP participation and FS transfers in a multivariate setting.

[Insert Table 1 about here]

Table 2 presents the cumulative probability of being poor at alternative poverty lines up to 150 percent of the Before-FS comprehensive income. For example, in 1979, 5.17 percent of the sample had Before-FS comprehensive incomes less than or equal to 25 percent of the official poverty line. After receiving food stamps this number fell to 4.42 percent of the sample. Overall, in each year considered about one half of all the persons in our sample have incomes ranging between 75 and 125 percent of the official poverty line. The data in Table 2 are used in the next section to calculate the percentage change in headcount poverty due to the food stamp program.

[Insert Table 2 about here]

In presenting the major findings of the research the report focuses on 1982 and 1990. Pairwise comparisons are at the heart of dominance method and selecting two years for the numerous comparisons and tests makes it easy to communicate the results. We use 1982 as our initial year rather than 1979 for two reasons. First, as discussed above, the 1979 sample sizes is much smaller than other years and the inference tests are somewhat sensitive to the sample size. Second, the imputation procedure used for deriving comprehensive income estimates for 1979 are less reliable than for other years. The empirical results are organized into related research questions and discussed in the five sub-sections below.

TABLE 1

Adult Equivalent Per Capita Comprehensive Income
and Food Stamp Transfers, Various Years (1990 Dollars)

Fraction of Poverty Line	1979		1982		1985		1989		1990	
	Income (1)	Food Stamps (2)	Income (3)	Food Stamps (4)	Income (5)	Food Stamps (6)	Income (7)	Food Stamps (8)	Income (9)	Food Stamps (10)
0.25	739	238	758	349	834	284	872	385	832	363
0.50	1844	450	1851	563	1903	527	1954	635	1943	657
0.75	2962	493	3018	559	3028	560	2989	613	2967	635
1.00	4093	461	4126	485	4022	481	3974	514	3972	518
1.25	4995	406	5102	383	4951	380	4972	404	4930	410
1.50	5673	368	5676	337	5517	335	5601	349	5554	354

Note: Last row is the sample average.

TABLE 2

Cumulative Probability of Being Poor by
Alternative Poverty Lines, Various Years

Fraction of Poverty Line	1979		1982		1985		1989		1990	
	Before-FS (1)	After-FS (2)	Before-FS (3)	After-FS (4)	Before-FS (5)	After-FS (6)	Before-FS (7)	After-FS (8)	Before-FS (9)	After-FS (10)
0.25	5.17	4.42	4.45	3.56	5.04	4.05	5.13	3.84	5.19	4.05
0.50	14.73	11.50	13.41	9.66	15.27	11.03	16.52	11.00	16.74	10.92
0.75	30.89	25.21	30.22	24.31	34.01	26.59	33.45	25.92	34.25	27.16
1.00	55.74	49.46	54.92	48.79	57.62	52.43	55.31	50.49	56.72	51.98
1.25	80.48	75.81	82.59	79.14	83.68	81.42	81.98	78.96	82.29	79.54
1.50	100.00	97.72	100.00	98.80	100.00	99.09	100.00	98.90	100.00	99.18

A. *Food Stamps, Headcounts, and Poverty Gaps*

This section addresses the following research questions:

- Given other tax and transfer programs affecting the poor, how did the FSP shift the distribution of income in the 1980s to influence official headcount measures of poverty?
- How do alternative specifications of the poverty line influence the findings concerning the effects of the FSP on headcount measures of poverty?
- How has the FSP affected income gap measures of poverty in the 1980s?

These questions can be addressed in a straightforward manner with micro measures of Before-FS and After-FS CPS incomes. To identify the poor, the poverty line for a particular CPS observation is computed using family specific microdata (weighted by persons) and the official poverty criteria. We then consider the reduction in headcount poverty as a result of the food stamp transfers in each of the five years considered. Using fractions of the official poverty line we evaluate the sensitivity of our results to the poverty line chosen.

Table 3 presents the percentage reduction in headcount poverty at alternative poverty lines (z), as a result of food stamp transfers for 1979, 1982, 1985, 1989, and 1990. Consider the first entry in Table 3 (row 1, col. 1), which corresponds to a poverty line of one-quarter ($z=0.25$) of the official level. The 16.77 percent entry for 1979 indicates the percentage reduction in the number of persons living in abject poverty as a result of food stamp transfers.¹⁰ As noted above, the poorest

10. This number is obtained by calculating the percentage change in columns 1 and 2 of Table 2.

among the poor do not receive the largest percentage reductions in headcount poverty from food stamps. However, for all poverty lines above 0.25 the percentage reductions decline monotonically as the poverty line is raised.

[Insert Table 3 about here]

Table 3 also highlights the necessity of examining alternative poverty lines when making comparisons of the effectiveness of the food stamp program at reducing poverty over time. If attention is focused exclusively on the official poverty line ($z = 1.0$) Table 3 shows that the impact of the FSP on headcount poverty has been declining throughout the period studied. While this conclusion is also valid for poverty lines set above the official standard ($z = 1.25$ and 1.50), it does not hold for poverty lines set below the official standard ($z = 0.75$, 0.50 , and 0.25). For example, the percentage reduction in poverty at a poverty line of one-half the official poverty line ($z = 0.50$) grows from 28.15 in 1979 to 53.28 in 1990.

It is also important to consider alternative poverty measures as well as headcounts. Table 4 shows the poverty reducing effects of the FSP in terms of percentage changes before and after food stamps for weighted income shortfalls (poverty gaps) at alternative poverty lines. The results in Table 4 are similar to Table 3 in that the poverty gap reduction at 25 percent of the official poverty line is smaller than at the next two higher poverty lines (0.50 and 0.75). The results for poverty gaps differ from the headcounts in that they show much larger percentage changes at the official poverty line and above.

TABLE 3

Percentage Reduction in Headcount Poverty at Alternative Poverty Lines
as a Result of Food Stamp Transfers, Various Years

Fraction of Poverty Line	1979 (1)	1982 (2)	1985 (3)	1989 (4)	1990 (5)
0.25	16.77	25.05	24.73	33.41	28.37
0.50	28.15	38.87	38.43	50.20	53.28
0.75	22.55	24.34	27.90	29.05	26.10
1.00	12.69	12.58	10.02	9.54	9.11
1.25	6.17	4.36	2.78	3.82	3.45
1.50	2.34	1.22	1.58	1.11	0.83

In other words, at values of $z \geq 1.0$, the FSP has major impacts on the intensity of poverty compared to headcount measures. For example, in 1990 the percentage poverty gap reduction at the official poverty line (26.03 percent) is nearly three times larger than the corresponding reduction in headcounts (9.11 percent). Finally, the use of poverty gaps rather than headcounts provides stronger evidence of the growing effectiveness of the FSP over time.

[Insert Table 4 about here]

B. The FSP and Poverty Dominance

In this section we address the following related questions:

- Does 1990 (marginally) poverty dominate 1982 at the first or second degree?
- Are the dominance (crossing) results statistically robust?

While Tables 3 and 4 provide interesting insights into the effectiveness of the FSP in reducing poverty, it is also of interest to test for first order (headcount) and second order (poverty gap) poverty dominance. Figures 1 and 2 above graphically illustrate these relationships and Tables 5 and 6 present the inference procedures used to test for marginal poverty dominance.¹¹

In applying the inference procedures, the objective is to determine if the marginal effect of the FSP in reducing poverty was greater in 1982 than in 1990, independent of the poverty line chosen.¹² To accomplish this task, we apply Foster and

11. It is not surprising to find that After-FS incomes are greater than or equal to Before-FS incomes and, therefore, first order dominance prevails. For this reason we do not present the results of the formal tests.

12. We use 1982 to represent the early period rather than 1979, as the 1979 taxes are imputed from the 1980 data (see the data section for a discussion of this imputation process).

TABLE 4

Percentage Reduction in Poverty Gaps at Alternative Poverty Lines
as a Result of Food Stamp Transfers, Various Years

Fraction of Poverty Line	1979 (1)	1982 (2)	1985 (3)	1989 (4)	1990 (5)
0.25	18.57	22.19	22.62	27.66	28.29
0.50	22.76	36.19	31.04	42.61	44.89
0.75	24.35	35.00	33.99	38.19	40.34
1.00	21.40	24.75	24.64	25.78	26.03
1.25	15.19	15.59	15.16	15.49	15.72
1.50	10.59	9.46	9.46	9.99	9.99

Shorrocks' Corollary 1 (first order dominance), which requires the food stamp transfers to be larger at *one or more poverty line* (while not being smaller at other poverty lines) in order to draw an unambiguous conclusion about the marginal impact of the FSP on headcount poverty. That is, we test the null hypothesis that there is no difference in the size of the food stamp transfers at any of the preselected poverty lines. Rejection of the null implies one of two outcomes. Alternative 1 is a finding that one year's food stamp transfers are larger (or at least no smaller) at each of the poverty lines selected; "acceptance" of Alternative 1 implies that the marginal effect of the FSP is unambiguously larger in one year than the other. Alternative 2 is a finding that the food stamp transfers in one year are significantly larger at some poverty lines and significantly smaller at others; "acceptance" of Alternative 2 implies that no unambiguous conclusion regarding the relative marginal effects of the FSP is possible. In summary, there are three possible outcomes from statistical testing: 1) there is no significant difference at any poverty line in the poverty reduction attributable to the FSP (the null hypothesis), 2) poverty reduction attributable to the FSP is larger at every poverty line in one year than another (the first alternative), or 3) the ordering of the poverty reduction across years is sensitive to the poverty line chosen (the second alternative).

To choose between the two competing alternatives, the null hypothesis is tested by estimating food stamp transfers (ordered by Before-FS income) as the conditional mean at each preselected

poverty line. Stated differently, the cumulative distribution function is approximated as a step function of the means of the following income classes:

- less than or equal to $0.25 z$,
- more than $0.25 z$ but $\leq 0.50 z$,
- more than $0.50 z$ but $\leq 0.75 z$,
- more than $0.75 z$ but $\leq z$,
- more than $1.25 z$ but $\leq 1.5 z$,

where z is the official poverty line. The effects of food stamp transfers on the poor are tested at each of the alternative poverty lines.

Table 5 uses the data from 1982 and 1990 to test for marginal headcount (first order) dominance. The table is organized as follows: columns 1 and 4 present Before-FS incomes, columns 2 and 5 present After-FS incomes (ordered by Before-FS), and columns 3 and 6 present the amount of the FS transfers with their standard errors. Figure 3 plots the conditional mean food stamp transfers from columns 3 and 6. The two curves cross between 75 and 100 percent of the official poverty line. This suggests that Alternative 2 described above characterizes food stamps and poverty in the U.S. between 1982 and 1990. If the crossing is statistically significant, then Foster and Shorrocks' Corollary 1 is violated.

[Insert Tables 5 about here]

[Insert Figure 3 about here]

Column 7 shows the results of the Bishop, Chow, and Formby (BCF) tests for matched pair dependent samples. In particular, we test whether food stamp transfers are larger within each

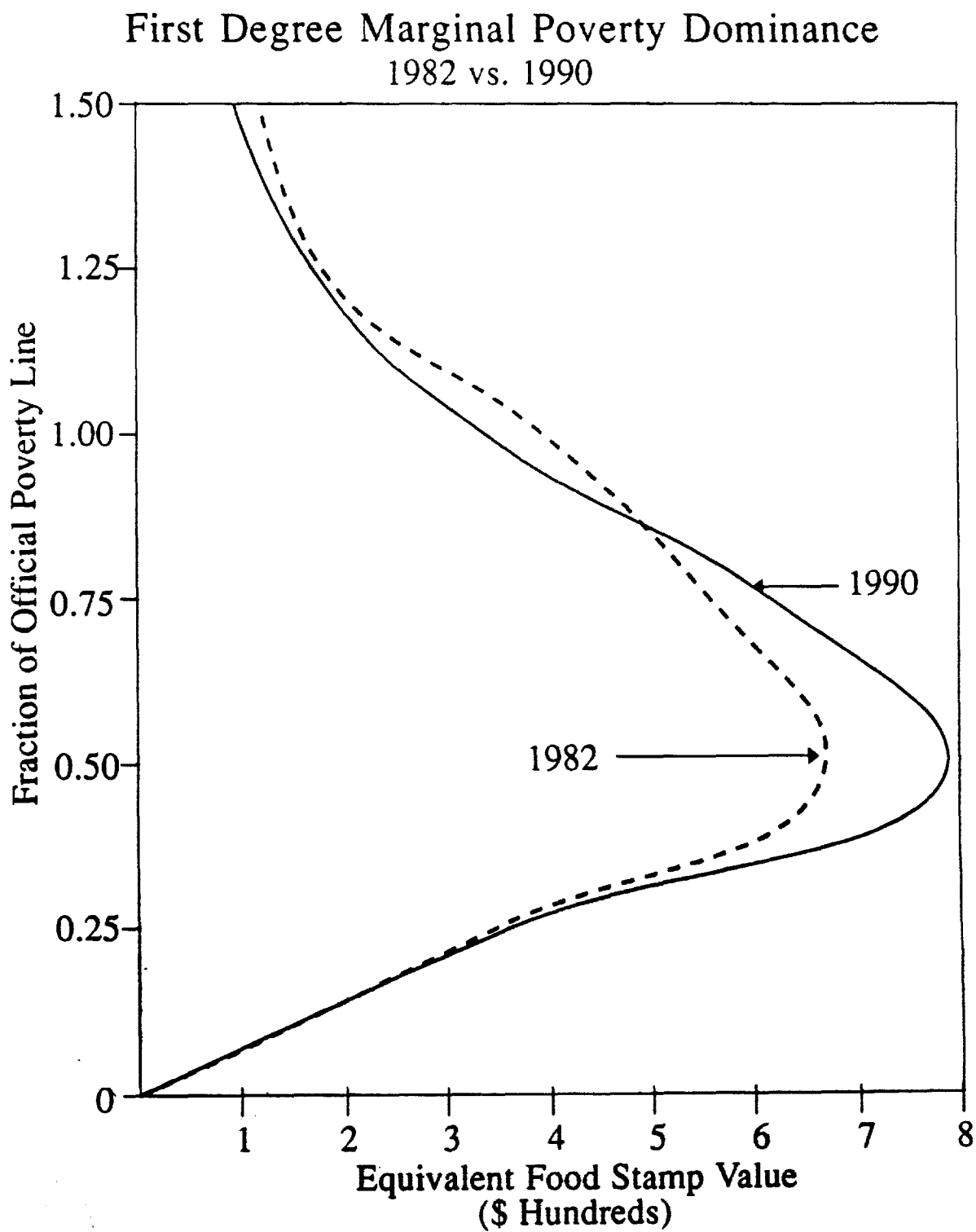
TABLE 5

First Degree (Headcount) Dominance Tests: 1982 vs. 1990
(1990 Dollars)

Fraction of Poverty Line	Conditional Means, 1982			Conditional Means, 1990			Test Statistic (7)
	Before-FS (1)	After-FS (2)	Food Stamps (3)	Before-FS (4)	After-FS (5)	Food Stamps (6)	
0.25	758	1107	349 (29)	832	1195	363 (28)	1.71
0.50	2394	3063	669 (29)	2442	3231	789 (28)	3.22*
0.75	3950	4506	556 (17)	3947	4561	614 (19)	2.51
1.00	5482	5877	395 (11)	5504	5842	338 (12)	-4.26*
1.25	7038	7218	180 (7)	7056	7227	171 (8)	-1.13
1.50	8399	8519	120 (7)	8452	8547	95 (6)	-3.56*

Note: Conditional means are the average between 0 and 0.25, 0.25 and 0.50, etc. Numbers in parentheses in col. 3 and col. 6 are standard errors. "*" denotes statistically significant differences between col. 3 and col.6 at the 0.05 level. (critical value = 2.63)

Figure 3



preselected poverty group. Consider first the test for differences in the amount of reduction in headcount poverty at the official poverty line ($z = 1.00$).¹³ In this case the test statistic is -4.26, which indicates that the reduction in poverty at the official poverty line attributable to the food stamp program was greater in 1982 than in 1990. If we choose 150 percent of the official poverty line, we can also conclude that the impact of the FSP is greater in 1982 than in 1990 (test statistic = -3.56). However, a poverty cut-off of one-half the official poverty line results in a positive and significant difference (test statistic = 3.22) indicating that the FSP was more effective in reducing headcount poverty in 1990 than in 1982. Therefore, the Foster-Shorrocks' Corollary 1 is violated and it is not possible to conclude that either year's marginal impact on headcount poverty reduction is greater than the other without placing severe restrictions on the poverty line income cut-off. Thus, whether the marginal effects of the FSP have more or less impact on headcount poverty in 1990 than in 1982 depends upon where the poverty line is drawn; therefore, unambiguous conclusions about first order dominance cannot be drawn over this period.

When a ranking is not obtained using first order dominance, it may be possible to obtain a ranking using second order

13. To maintain the size of the joint test of two vectors of sample conditional means, the critical values are determined from the Student Maximum Modulus (SMM) distribution. That is, an approximately α level test of the equality of two vectors of conditional means rejects each of the k subhypotheses if $T_1 > m_\alpha(k, 1)$, where $m_\alpha(k, 1)$ is the upper α critical value of the SMM distribution with ∞ degrees of freedom.

dominance. This focuses on a different concept of reducing poverty, namely, the poverty gap. For example, Foster-Shorrocks' Corollary 2 demonstrates that second order dominance implies poverty gap dominance, which is a weaker condition than headcount poverty dominance. As noted above, while first order dominance requires comparing the cdf's F and G , estimated by the conditional means, second order dominance integrates the area between F and G , and can be estimated by the cumulative means.

Table 6 provides the cumulative means for Before-FS income, After-FS income, the food stamp transfer, and their standard errors for 1982 and 1990. Thus, Table 6 is similar to Table 5, but contains the information required to make second order dominance comparisons of poverty across time. Evidence that the cumulated food stamp transfers (ordered by Before-FS income and compared at alternative poverty lines) are significantly larger in 1990 as compared to 1982 is necessary and sufficient for concluding that the marginal impact of the FSP on reducing poverty gaps is increasing over time.

[Insert Tables 6 about here]

Several important differences in Tables 5 and 6 deserve emphasis. First, if we restrict our analysis to the official poverty line, Table 6 reverses the conclusion from Table 5. That is, while the 1982 headcount reduction is significantly greater than the 1990 headcount reduction, the opposite holds for the poverty gap reductions. However, this result is a peculiarity of comparing headcounts and poverty lines at only one poverty line. Recall that the 1982 headcount reduction was greater than the

TABLE 6

Second Degree (Poverty Gap) Dominance Tests: 1982 vs. 1990
(1990 Dollars)

Fraction of Poverty Line	Cumulative Means, 1982			Cumulative Means, 1990			Test Statistic (7)
	Before-FS (1)	After-FS (2)	Food Stamps (3)	Before-FS (4)	After-FS (5)	Food Stamps (6)	
0.25	758	1107	349 (29)	832	1195	363 (28)	1.71
0.50	1851	2414	563 (20)	1943	2600	657 (21)	7.73*
0.75	3018	3577	559 (13)	2967	3602	635 (14)	8.02*
1.00	4126	4611	485 (8)	3972	4490	518 (9)	4.00*
1.25	5102	5485	383 (6)	4930	5340	410 (6)	3.00*
1.50	5676	6013	337 (5)	5554	5908	354 (5)	2.41

Note: Cumulative means are the average between 0 and 0.25, 0 to 0.50, etc. Numbers in parentheses in col. 3 and col. 6 are standard errors. ** denotes statistically significant differences between col. 3 and col. 6 at the 0.05 level. (critical value = 2.63)

1990 headcount reduction is dependent on the poverty line chosen. This is not the case, however, for the poverty gaps. Figure 4 plots the cumulative food stamp transfers up to 150 percent of the official poverty line. In this case, the 1990 food stamp transfers are larger at every preselected poverty line. The positive and significant differences in column 7, rows 2-5, and the finding of no significant difference at rows 1 and 6, ensures that *the marginal impact of the FSP in 1990 on poverty gaps is larger at one or more poverty lines and no smaller at other poverty lines than the marginal impact of the FSP in 1982.*

[Insert Figure 4 about here]

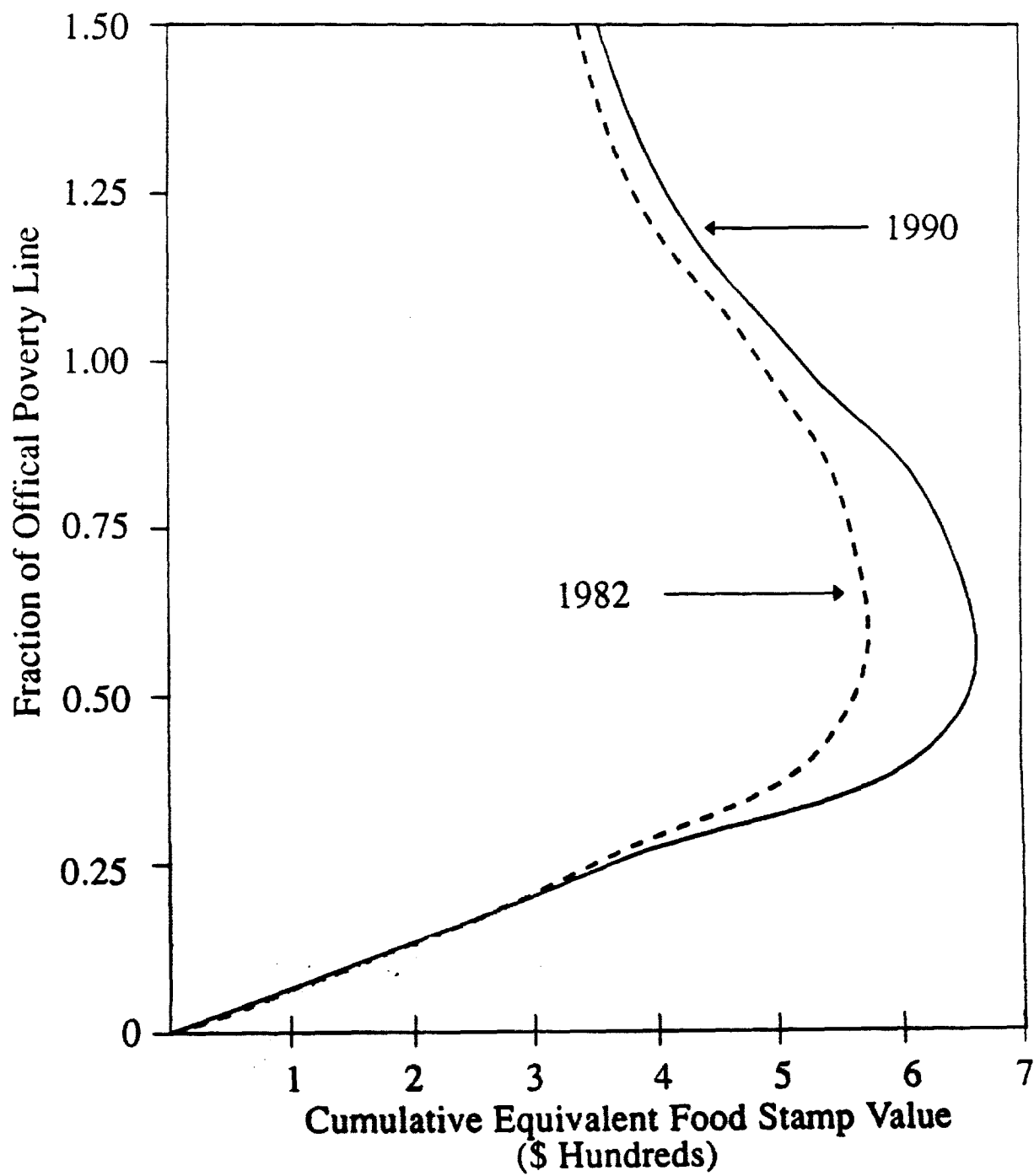
C. *The FSP and the Distribution of Income Among the Poor*

This section considers the following research questions:

- How does the receipt of food stamp transfers (versus no FSP transfers) affect the distribution of income among the poor?
- Among the low income population, are the food stamp transfers progressive? Has the transfer progressivity (regressivity) changed over time?
- How severe are the food stamp transfer induced rerankings (mobility) among the poor?

We investigate these questions in several related ways. First, we apply Atkinson's Lorenz dominance criterion. It is widely agreed that the Lorenz curve is the most general indicator of inequality. In order to avoid the multiplicity of index numbers it is necessary and of interest to consider Lorenz curves directly. This is the most direct and unambiguous approach to addressing Sen's (1976) concern about the distribution of income among the poor. We implement this aspect of the research by using CPS microdata to construct Before-FS and After-FS Lorenz

Figure 4
Second Degree Marginal Poverty Dominance
1982 vs. 1990



curves and apply BCF tests to make inferences concerning the marginal impact of food stamps on the distribution of income among the poor.¹⁴ Second, we consider the question of transfer progressivity (vertical equity) using the dominance method and BCF inference methods. Finally, we construct mobility matrices of Before-FS and After-FS incomes in order to evaluate the rerankings ("leap-frogging") of households due to the FSP.¹⁵

We focus on a sample of low income recipients with comprehensive, Before-FS incomes of 150 percent of the official poverty line or less. Table 7 shows the distribution of income among this group in terms of Before-FS and After-FS Lorenz curves for two years and compare 1982 and 1990. The specific points at which we estimate the Lorenz ordinates correspond to six different poverty lines. For example, the first entry for 1982 shows that those with incomes less than or equal to 25 percent of the official poverty line (4.45 percent of the low income population) had only 0.59 percent of the income of the low income group. At the official poverty line ($z = 1.00$), 54.9 percent of the low income sample had 39.9 percent of the total Before-FS income. In contrast, these same people received 42.13 percent of the After-FS income. For 1990, 56.7 percent of the low income sample was officially poor when evaluated in terms of Before-FS

14. More precisely, we compare the Before-FS Lorenz curve to the After-FS concentration curve. The After-FS concentration curve is simply the cumulative share of After-FS income ordered by Before-FS income.

15. Given the "correct" equivalence scale, this reranking can be viewed as a measure of horizontal equity. See Lambert (1991) for an excellent discussion of the relationship between both vertical equity and progressivity and horizontal equity and reranking.

income and received 40.6 percent of sample income. But in terms of After-FS income, these same people had 43.1 percent of income.

Inspection of Table 7 reveals that the FSP had an equalizing effect on incomes among the poor in both 1982 and 1990. The "*" at 0.50 and 0.75 in Table 7 indicates that food stamp transfers are equalizing insofar as Before-FS incomes are less equal than the After-FS incomes (using the BCF test) in each of the two years considered.

[Insert Table 7 about here]

Table 8 expands upon the information in Table 7 and evaluates the progressivity of the FSP and tests for changes between 1982 and 1990. It is well established in the literature relating to taxes that progressivity is dependent on both the distribution of income and the distribution of taxes. By analogy, FSP progressivity depends upon the distribution of income as well as the distribution of food stamps. Thus, to analyze the progressivity of the FSP we treat food stamps like negative taxes and compare the distribution of FS transfers to the distribution of Before-FS incomes.¹⁶ Holding other factors constant, the greater the share of food stamps received by the persons at the bottom of the sample of low income recipients, the greater the transfer progressivity. Figure 5 plots the cumulative shares of food stamps ordered by Before-FS income for each alternative poverty line (Table 8, columns 2 and 5). The 1990 Lorenz-type curve lies everywhere to the right of the 1982

16. In this analysis we use Musgrave and Thin's (1945) liability measure of progressivity. For a discussion of the relationship between inequality measurement and progressivity measurement, see Lambert (1991).

TABLE 7

Distribution of Income among the Poor Before-FS and After-FS,
1982 and 1990.

Fraction of Poverty Line	1982			1990		
	Percent of Persons (1)	Before-FS (2)	After-FS (3)	Percent of Persons (4)	Before-FS (5)	After-FS (6)
0.25	4.45	0.59	0.81	5.19	0.77	1.05
0.50	13.41	4.38	5.39*	16.74	5.85*	7.37*
0.75	30.22	16.08	17.98*	34.25	18.23*	20.88*
1.00	54.92	39.93	42.13	56.72	40.56	43.10
1.25	82.59	72.24	75.34	82.29	73.05	74.38
1.50	100.00	100.00	100.00	100.00	100.00	100.00

Note: "*" denotes post-transfer Lorenz ordinates is significantly larger than the pre-transfer Lorenz ordinates at the 0.05 level.

curve, indicating that at incomes corresponding to each poverty line considered, the cumulative share of food stamps is larger in 1990 and 1982.

[Insert Table 8 about here]

[Insert Figure 5 about here]

In a manner similar to the dominance comparisons in Tables 5 and 6, we make progressivity comparisons by evaluating the size of the differences between the Before-FS income distribution and the distribution of food stamps. Columns 1 and 4 of Table 8 repeat the Before-FS Lorenz ordinates of Table 7 while columns 2 and 5 present the distribution of food stamps. Column 7 provides test statistics for the null hypothesis that the differences between the Before-FS incomes and the food stamp transfers are equal at each point in the distribution. A rejection of this hypothesis implies an increasing degree of transfer progressivity over time. The "*"s indicate that the progressivity of food stamp transfers was significantly greater in 1990 than in 1982.

Both the analysis of the effect on the income distribution (Table 7) and the analysis of transfer progressivity (Table 8) suggest that food stamp transfers make the distribution of income among the poor more equal. It is important to interpret this finding in light of earlier observations concerning the small absolute size of food stamp transfers flowing to those below 25 percent of the poverty line. These two sets of results can be reconciled as follows: *while persons below 25 percent of the poverty line receive a smaller absolute transfer than those at 50 percent and above, the findings of Tables 7 and 8 imply that they*

TABLE 8

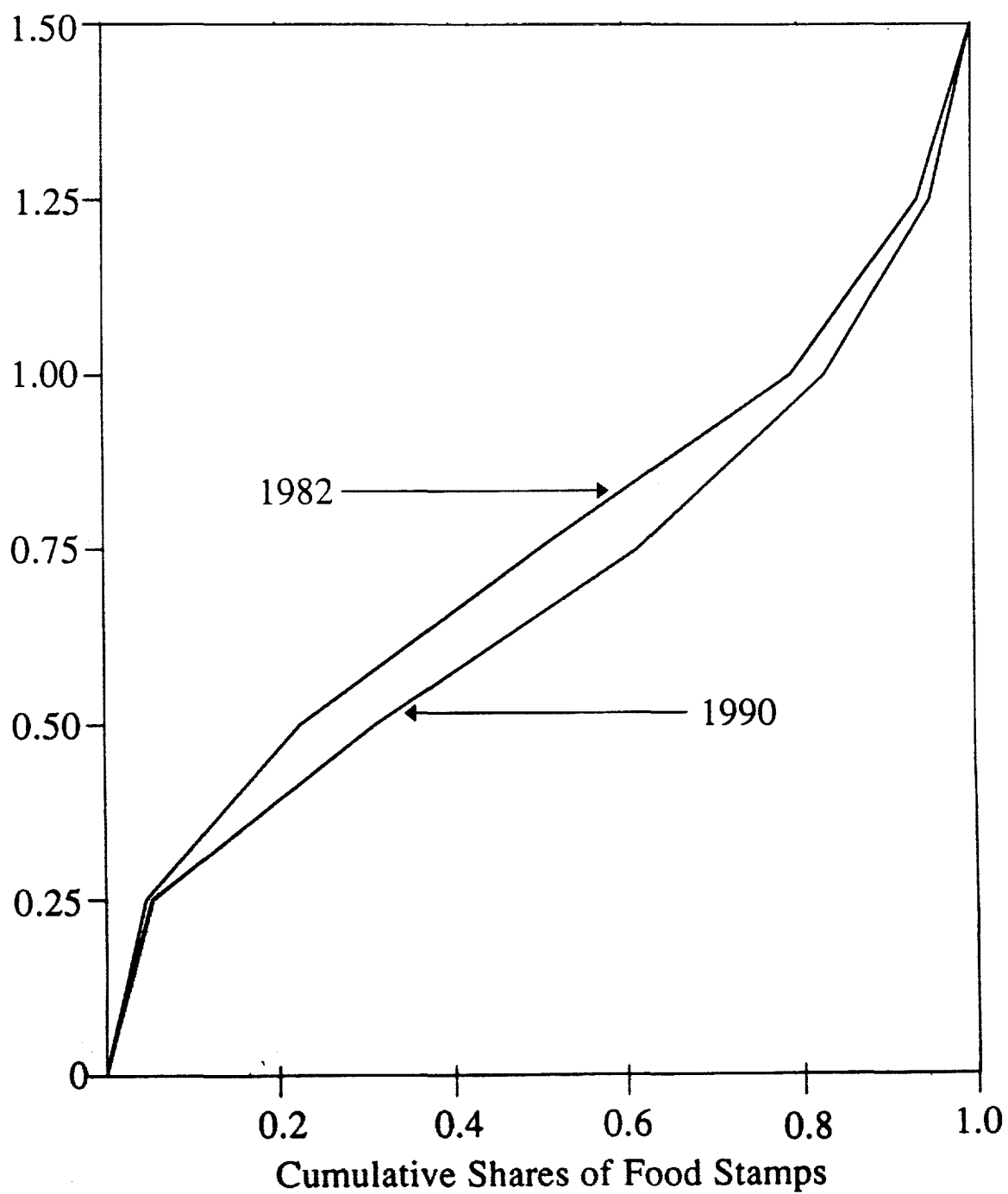
Food Stamp Transfer Progressivity Comparison, 1982 and 1990

Fraction of Poverty Line	Lorenz Ordinates, 1982			Lorenz Ordinates, 1990			Test Statistic (7)
	Income (1)	Food Stamps (2)	Difference (3)	Income (4)	Food Stamps (5)	Difference (6)	
0.25	0.59	4.60	4.01 (0.60)	0.77	5.31	4.54 (0.64)	0.60
0.50	4.38	22.38	18.01 (1.20)	5.85	31.04	25.19 (1.41)	3.84*
0.75	16.08	50.11	34.03 (1.47)	18.23	61.44	43.13 (1.46)	4.40*
1.00	39.93	79.02	39.09 (1.20)	40.56	82.88	42.31 (1.16)	1.92
1.25	74.24	93.82	19.58 (.95)	73.05	95.24	22.19 (.97)	1.93
1.50	100.00	100.00	-	100.00	100.00	-	-

Note: Numbers in parentheses in col. 3 and col. 6 are standard errors. "*" denotes statistically significant difference between col. 3 and col. 6 at 0.05 level. (critical value = 2.57)

Figure 5

Cumulative Share of Food Stamps, 1982 and 1990
(Ordered by Before-FS Income)



receive the largest share of transfers relative to their incomes.

Tables 9a and 9b provide income mobility matrices for the low income sample, which permit us to evaluate the degree of reranking that occurs as a result of the FSP. On the horizontal axis, incomes are ordered by adult equivalent per capita Before-FS income. On the vertical axis, incomes are ordered by adult equivalent per capita After-FS income. The diagonal elements of Table 9a and 9b show the percentage of equivalent persons whose quintile position remains unchanged as a result of the FSP and the off-diagonal elements show where those who left their original quintile ended up. Both tables are quite similar, suggesting that there is little change in the degree of reranking over time. In each case the diagonal elements range from more than 80 percent remaining after the transfer in the first and fifth quintiles to approximately 65 percent remaining after the transfer in the second and third quintiles.

[Insert Table 9 about here]

Evaluating mobility, i.e., deciding what constitutes a little and what constitutes a lot of mobility, is problematic. However, several contrasts may be helpful. To provide a benchmark, we compare the 1989 position of "poor" persons to their 1990 position.¹⁷ In this case, none of the diagonal elements is greater than 33 percent. This suggests that the mobility induced by the FSP is small relative to general mobility among the poor in a two year period. In contrast to this example

17. "Poor" is defined as less than 150 percent of the official poverty line in both 1989 and 1990.

TABLE 9A

Food Stamp Transfer Induced Mobility, 1990

Quintiles of Before-FS Income	Quintiles of After-FS Income				
	1	2	3	4	5
1	82	18	1		
2	18	62	19		
3		21	66	12	1
4			14	77	10
5				11	89

TABLE 9B

Food Stamp Transfer Induced Mobility, 1982

Quintiles of Before-FS Income	Quintiles of After-FS Income				
	1	2	3	4	5
1	83	17	1		
2	17	64	17	1	
3		19	68	12	1
4			15	74	11
5				13	88

of extreme mobility, Bishop, Chow, Formby, and Ho (1993) construct mobility matrices for tax evasion. In their case, mobility is much smaller than in Table 9; they find that no diagonal element is greater than 93 percent. Overall, we conclude that while there is some transfer-induced "leap-frogging" associated with food stamp transfers, it does not appear to be large.

D. Sensitivity of the Results to the Time Period, Income Measure and Equivalence Scale

The research questions addressed in this section are as follows:

- How sensitive are the results relating to food stamps and poverty to the one year accounting period used in measuring income?
- How sensitive are the results to the specific measure of income chosen?
- How sensitive are the results to the equivalence scale used?

Cowell (1984) has shown that the size and dispersion of incomes are influenced by the arbitrary choice of the one year time frame that is typically used in studies of income inequality and poverty. Extending the time frame beyond a year results in a more accurate assessment of permanent income and reduces dispersion and inequality. Similarly, a longer time frame eliminates transitory poverty and focuses on those who are permanently poor. The overlap feature of the CPS survey allows us to measure the effects of food stamps on poverty using a two year time frame. It is of interest to determine whether the results are sensitive to this change in the time frame.

Table 10 evaluates the effects of food stamp transfers on

persons living in families that were "poor" in two successive years. Table 10a shows the results for 1990 and Table 10b provides comparable estimates for 1982.¹⁸ Column 1 of Table 1 provides the amount of food stamp transfers by poverty cut-off for the restricted sample and is comparable to column 10 of Table 2. For every income level and poverty line considered, the size of the food stamp transfer is larger when the sample is restricted to the multi-year poor as opposed to the single year. For example, in 1990 persons with incomes less than or equal to 25 percent of the poverty line had single year food stamp transfers of \$363, while the multi-year sub-sample received \$505, or 39 percent more. At the official poverty line ($z = 1.00$) the corresponding values are \$518 and \$624, or the multi-year poor received 20 percent larger food stamp transfers. Column 2 shows the resulting reduction in headcount poverty and is comparable to column 5 of Table 4. Again, at each poverty cut-off considered the multi-year impact is larger than the single year impact. For example, 1990 the single year headcount reduction at 0.25 is 28.37 percent as opposed to 41.67 percent for the multi-year sub-sample. The change is less dramatic at higher poverty cut-offs: at $z = 1.00$, the single year reduction is 9.11 percent compared to 10.96 percent for the multi-year sub-sample. A comparison of Table 10a and 10b reveals similar findings for 1982. The implication of these results is clear; food stamps have a larger impact in reducing poverty when better approximations of

18. The 1982 sample contains 1982 incomes and transfers for families that were poor in both 1982 and 1983. The 1990 sample contains 1990 incomes and transfers for families that were poor in both 1989 and 1990.

permanent income are used. Stated differently, annual income measures understate the effects of the FSP.

[Insert Table 10 about here]

Table 11 provides information concerning the effects of using alternative measures of income in assessing the effectiveness of the FSP in 1990. Four alternative definitions of income are provided: Census money income (market incomes plus pure cash transfers), comprehensive income (which adds direct taxes and some in-kind transfers, the basic measure used in this report), comprehensive income plus imputed housing value, and comprehensive income plus imputed housing value plus imputed medical benefits.¹⁹

[Insert Table 11 about here]

A striking result from Table 11 is the size of the food stamp transfers for the poorest group ($z = 0.25$) for alternative income definitions. If the poverty line is set using Census money income, those persons at 25 percent of the poverty line receive \$548 in food stamps as compared to \$363 when the poverty line is set using comprehensive income. In fact, the impact of the food stamp transfers is smaller at every poverty cut-off for our basic income measure, comprehensive income (columns 3-4), when compared to both the less inclusive Census money income definition (columns 1 and 2) or the two more inclusive income definitions (columns 5-8).²⁰ The implication of this result is

19. See Section III for a more detailed discussion of these income definitions.

20. We point out that the variation in the impact of the FSP across different income definitions declines as we select poverty cut-offs at or above the official poverty line.

TABLE 10A

Effect of Food Stamps on Multi-Year Poor, 1990

Fraction of Poverty Line	Equivalent Food Stamp Value (1)	Headcount Percentage Poverty Reduction (2)	Poverty Gap Percentage Poverty Reduction (3)
0.25	505	41.67	42.94
0.50	788	70.09	62.92
0.75	745	30.73	52.80
1.00	624	10.96	32.51
1.25	519	4.04	19.39
1.50	464	0.63	12.56

Note: Multi-year poor means that the income recipient has a comprehensive equivalent income less than 150 percent of the poverty line in both 1989 and 1990. Food stamp value is cumulative mean; last row is overall sample mean.

TABLE 10B

Effect of Food Stamps on Multi-Year Poor, 1982

Fraction of Poverty Line	Equivalent Food Stamp Value (1)	Headcount Percentage Poverty Reduction (2)	Poverty Gap Percentage Poverty Reduction (3)
0.25	490	43.01	33.33
0.50	706	52.73	53.51
0.75	692	32.09	49.24
1.00	588	15.52	32.58
1.25	482	4.57	19.78
1.50	438	1.05	12.52

Note: Multi-year poor means that the income recipient has a comprehensive equivalent income less than 150 percent of the poverty line in both 1982 and 1983. Food stamp value is cumulative mean; last row is overall sample mean.

TABLE 11

The Effects of Food Stamps on Head Count Poverty under Alternative Income Definitions, 1990

Fraction of Poverty Line	Census Money Income		Comprehensive Income		Comprehensive Income with Imputed Housing		Comprehensive Income with Imputed Housing & Imputed Medical Benefits	
	Food Stamps (1)	Percentage Poverty Reduction (2)	Food Stamps (3)	Percentage Poverty Reduction (4)	Food Stamps (5)	Percentage Poverty Reduction (6)	Food Stamps (7)	Percentage Poverty Reduction (8)
0.25	548	46.99	363	28.37	446	42.37	447	42.95
0.50	726	60.84	657	53.28	737	67.77	716	63.39
0.75	664	21.97	635	26.10	683	27.23	643	23.21
1.00	542	7.89	518	9.11	579	11.60	549	10.50
1.25	440	3.02	410	3.45	462	4.60	452	5.00
1.50	355	0.85	354	0.83	386	1.04	397	2.38

that food stamps seem to be allocated among the low income population on the basis of Census money income, which is not as meaningful in assessing the well-being of the poor as other more comprehensive measures.

Table 12 reports on the analysis of the sensitivity of the results to the specific equivalence scale used in the study. In particular, Table 12 provides alternative estimates of the size of food stamp transfers and the percentage reduction in headcount poverty in 1990 for different equivalent scales.²¹ Table 12a provides estimates of four alternative equivalence scales for a single adult and a married couple with children. The Orshansky scale (column 1) is the official U.S. equivalence scale, and is the standard used in this report. Column 2 shows that the Orshansky scale is closely approximated in larger family sizes by the square root of the number of persons in the family. Column 3 illustrates the "one-half rule" popularized by the Luxembourg Income Study project.²² As an extreme, we also consider a per capita scale or equal weights to each person, regardless of age and family size (column 4).

[Insert Table 12 about here]

Table 12b provides the size of the transfers and the percentage reduction in headcount poverty at alternative poverty lines. Given the variation in adult equivalency, we normalize the food stamp transfers by the overall sample means. Thus, in

21. Appendix A provides a detailed description of the Orshansky equivalence scales used throughout this report.

22. See Buhmann et al. for a discussion of this and other alternative equivalence scales.

TABLE 12A

Weights for Alternative Equivalence Scales

Family Size	Orshansky (1)	Square Root Rule (2)	One-Half Rule (3)	Per Capita (4)
Single Adult	1	1	1	1
Married Couple	1.29	1.41	1.5	2
1 Child	1.55	1.73	2	3
2 Children	1.95	2	2.5	4
3 Children	2.29	2.23	3	5
4 Children	2.57	2.45	3.5	6

TABLE 12B

Effect of Equivalence Scale Choice on Head Count Poverty, 1990.

Fraction of Poverty Line	Orshansky Scales		Square Root Rule		One-Half Rule		Per Capita	
	Food Stamps (1)	Percentage Poverty Reduction (2)	Food Stamps (3)	Percentage Poverty Reduction (4)	Food Stamps (5)	Percentage Poverty Reduction (6)	Food Stamps (7)	Percentage Poverty Reduction (8)
0.25	1.03	28.37	1.06	22.97	1.50	47.47	1.94	57.58
0.50	1.86	53.28	1.83	50.68	1.94	42.22	1.52	9.15
0.75	1.79	26.10	1.72	23.67	1.59	10.83	1.14	1.27
1.00	1.46	9.11	1.41	8.99	1.18	0.42	1.05	0.43
1.25	1.16	3.45	1.11	3.09	1.01	0.00	1.01	0.00
1.50	1.00	1.00	1.00	0.55	1.00	0.00	1.00	0.00

Note: Food stamp value is ordered by pre-transfer income, cumulated and normalized.

column 1 we find that the lowest poverty group based on the Orshansky scales ($z = 0.25$) receives 1.03 times the average food stamp transfers for that column. In contrast, on an unadjusted per capita basis the poorest group receives nearly twice (1.94) the average transfer in column 7. As noted above, the square root rule (col. 3) is very similar to the official Orshansky rule, whereas, for the poorest persons the one-half rule (col. 5) lies between the Orshansky-square root rules and the per capita rule.

In terms of headcount poverty reduction, the per capita rule is most heavily weighted towards the bottom of the distribution. For $z = 0.25$, we find the per capita scale showing a 57.58 percent decline in headcount poverty (col. 8) as opposed to 22.97 percent for the square root rule (col. 4). However, at the official poverty line ($z = 1.00$), the use of a per capita or one-half equivalence scales implies that the food stamp program has a negligible effect (less than 0.50 percent) on poverty. Interestingly, the official Orshansky scales show the largest decline in poverty at the official poverty line (9.11 percent).

E. Factors Affecting Food Stamp Program Participation and Benefits Received

One of the important findings in the above sections is that the least well-off group, those with less than 25 percent of the poverty line income, receive a smaller level of food stamp transfers. This leads to two important questions:

- If we correct for differences in demographic, social and economic factors, are the families in the lower ranges of the income distribution more or less likely than other poor

families to participate in the FSP?

- If we correct for differences in demographic, social and economic factors, do the families in the lowest ranges of the income distribution receive the largest food stamp transfers?

The rich demographic, social and economic microdata contained in the Merge files will be used as explanatory variables in a probit model of participation in the FSP. Furthermore, we can use these explanatory variables to predict the level of food stamp benefits received. Food stamp benefits are dependent upon participation in the FSP. Significant numbers of low income recipients do not participate. Consequently, there is a possibility of selectivity bias in the sample of food stamp recipients. To correct for this, we estimate the benefits equation using Heckman's (1976) selectivity bias correction method.²³

Table 13 lists the variables used in the participation and benefits equations. We use data from the Type 1 sample for CPS 1991, which is described in detail above. Sample means are reported separately for the participants and nonparticipants in the FSP in columns 2 and 3 of Table 13.²⁴ Nearly one-third of the families in our sample are participants. Over 86 percent of the participants have incomes below the official poverty line, compared to 57.2 percent of nonparticipants. Over three-fourths of FSP participants also participate in other in-kind transfer programs (school lunches, housing and energy subsidies), compared

23. Formally, our model is equivalent to a familiar equation system in labor economics, which involves a employment participation equation and a labor earnings equation, with the latter corrected for selectivity bias.

24. A small number of FSP participants are lost by restricting the sample to families with comprehensive, equivalent incomes less than 150 percent of the official poverty line.

to less than one-third of nonparticipants. Urban residents and families headed by a nonwhite, female, or disabled person are disproportionately represented among the participants. On the other hand, families that own their home, those containing an elderly person, and families headed by an a high school graduate or an elderly person are disproportionately represented among the nonparticipants.

[Insert Table 13 about here]

The results from the participation equation are reported in Table 14. The dependent variable is equal to 1 if the family receives food stamps and zero otherwise. The vector of explanatory variables includes: age, Census region, level of urbanization, participation in other government in-kind transfer programs, home ownership, family composition, and the status of the head with respect to disability, education, race, and sex. The remaining explanatory variables are the dummy variables for comprehensive family income including the value of medical benefits and owner occupied housing.²⁵ The coefficient of each income group indicates the likelihood of FSP participation relative to the excluded group--families with equivalent comprehensive incomes below 25 percent of the official poverty line.

[Insert Table 14 about here]

The results in Table 14 reveal that the likelihood of participation in the FSP is significantly higher for families

25. Since we are looking at only one time period in this section of the report we include the rental value of owner-occupied housing, which is not available in the early non-cash Benefit tapes.

TABLE 13

Means of Variables

Variable	Sample ^a (1)	Participants (2)	Nonparticipants (3)
Participation rate ^b	0.329		
Needs-adjusted value of food stamps received		883.201	
POV ₀ : below 25% of the poverty line	0.077	0.081	0.075
POV ₁ : between 25% and 50% of the poverty line	0.143	0.243	0.094
POV ₂ : between 50% and 75% of the poverty line	0.188	0.264	0.150
POV ₃ : between 75% and 100% of the poverty line	0.260	0.273	0.253
POV ₄ : between 100% and 125% of the poverty line	0.203	0.112	0.247
POV ₅ : between 125% and 150% of the poverty line	0.130	0.027	0.180
Northeast	0.198	0.227	0.184
Midwest	0.217	0.222	0.215
South	0.351	0.369	0.342
Urban	0.330	0.370	0.310
Rural	0.466	0.465	0.467
Receives in-kind transfers other than food stamps	0.465	0.770	0.316
Owms home	0.303	0.190	0.358
Small child in family	0.125	0.137	0.119
Elderly person in family	0.216	0.138	0.255
High school graduate (head)	0.543	0.460	0.583
Age (head)	43.719	40.868	45.117
Nonwhite (head)	0.231	0.333	0.181
Female (head)	0.567	0.687	0.508

TABLE 13 (continued)

Means of Variables

Variable	Sample ^a (1)	Participants (2)	Nonparticipants (3)
Disabled (head)	0.214	0.282	0.181
Needs-adjusted family income ^c		4932.171	
Number of income earners		0.397	
Lambda ^d		0.792	

^aThe sample includes families with needs-adjusted, comprehensive incomes less than 150 percent of the official Census poverty line (10,933 families).

^bParticipates in the food stamp program (1=yes; 0=no).

^cComprehensive family income, including all in-kind transfers (except food stamps), taxes, and the rental value of owner-occupied housing, expressed in adult-equivalent units.

^dCorrection factor for sample selection bias.

TABLE 14

Food Stamp Program Participation Equation*

Explanatory Variable	Maximum Likelihood Estimate (1)	T-Statistic (2)
Constant	-0.992	-12.186
POV ₁ : between 25% and 50% of poverty line	0.443	7.215
POV ₂ : between 50% and 75% of poverty line	0.252	4.276
POV ₃ : between 75% and 100% of poverty line	0.018	0.314
POV ₄ : between 100% and 125% of poverty line	-0.392	-6.392
POV ₅ : between 125% and 150% of poverty line	-0.965	-12.853
Northeast	0.197	4.396
Midwest	0.193	4.385
South	0.238	5.946
Urban	0.068	1.625
Rural	0.161	4.101
Receives other in-kind transfers	1.031	35.177
Owne home	-0.322	-9.188
Small child in family	0.191	5.465
Elderly person in family	-0.183	-3.461
High School graduate (head)	-0.266	-8.782
Age (head)	-0.008	-5.880
Nonwhite (head)	0.269	7.840
Female (head)	0.308	9.856
Disabled (head)	0.398	11.014
-2 (log likelihood ratio)	3759.100	
Observations	10,933	

Source: Current Population Survey, 1991

*Sample includes families with needs-adjusted, comprehensive incomes less than 150 percent of the official census poverty line. Dependent variable: Receives food stamps (1=yes; 0=no).

living in Census regions outside the West, in rural (as opposed to suburban) locations, for families that receive other in-kind transfers from the government or that include a small child, and for families where the head is nonwhite, female, or disabled. Conversely, the likelihood of participation in the FSP is significantly lower for families that own their home, that contain an elderly person, and for those where the head is older, or whose head is a high school graduate. Our results also show that urban residence has a statistically insignificant effect on participation in the FSP.²⁶

Table 14 can be used to identify relative participation rates among different segments of the poor. The results indicate that two coefficients (POV_1 and POV_2) are positive and significant, and one that is insignificant (for POV_3). These results imply that families with equivalent incomes between 25 and 75 percent of the official Census poverty line are more likely to participate in the FSP than families with lower incomes. Comparing families below 25 percent of the poverty line with families between 75 and 100 percent of the poverty line, we find no significant difference in the likelihood of

26. This group of findings confirms several well-established results from previous studies of FSP participation, which rely on data from the late 1970s or early 1980s. These studies have found that the likelihood of participation diminishes as the age and education level of the family head increase (Moffitt (1983), Fraker and Moffitt (1988)) and when the family owns its own home (Ranney and Kushman (1987)). Conversely, the likelihood of participation in the FSP increases with participation in other transfer programs (Ranney and Kushman (1987), Fraker and Moffitt (1988)), when children are present (Moffitt (1983), Fraker and Moffitt (1988)) and with minority status of the family head (Fraker and Moffitt (1988)). Some of these family characteristics are closely related to the benefit formula for the FSP (e.g., owns home) or the eligibility requirements (e.g., the family is headed by a disabled person).

participation. These results fail to confirm our expectation that FSP participation declines as the family's income level increases.

Table 15 presents the results from the food stamp benefits equation. The dependent variable is the adult equivalent food stamp transfer (weighted by the family). The explanatory variables include adult equivalent income and its square, the number of income earners in the family, binary indicators of Census region, level of urbanization, home ownership, participation in other government in-kind transfer programs, family composition, and the status of the head with respect to education, race and sex. Heckman's (1976) correction factor for selectivity bias is the remaining explanatory variable.

[Insert Table 15 about here]

The results in Table 15 show that comprehensive equivalent family income has no significant effect on food stamp benefits. It is important to emphasize that the benefits equation is estimated only on participating families. Thus, the low participation rates among the poorest families are not driving this result. We also find that food stamp benefits decline under the following conditions: as the number of income earners in the family increases (holding family income constant), with rural residence and receipt of other in-kind transfers, when a small child is present, as the age of the head increases, and when the family is headed by a disabled person. The negative and significant coefficient of the disability variable may indicate that the costs of FSP participation (e.g., transportation to the

TABLE 15

Food Stamp Benefits Equation^a

Explanatory Variable	Parameter Estimate (1)	T-Statistic (2)
Constant	1727.799	15.570
Needs-adjusted family income	-0.016	-0.872
(Needs-adjusted family income) ²	0.0000002	0.102
Number of income earners	-182.320	-8.254
Northeast	51.641	1.691
Midwest	67.076	2.257
South	60.448	2.190
Urban	22.473	0.812
Rural	-61.768	-2.273
Owns home	97.597	3.693
Receives in-kind transfers other than food stamps ^b	-156.279	-3.137
Small child in family	-53.968	-2.232
Elderly person in family	-27.757	-0.750
High School graduate (head)	75.675	3.543
Age (head)	-4.049	-4.370
Nonwhite (head)	-16.682	-0.733
Female (head)	-36.562	-1.394
Disabled (head)	-234.022	-8.752
Lambda ^c	-489.264	-8.056
R-square	0.193	
Observations	3,596	

Source: Current Population Survey, 1991

^aSample includes families with needs-adjusted, comprehensive incomes less than 150 percent of the official census poverty line that receive food stamp benefits. Dependent variable: needs-adjusted value of food stamps received.

^bSchool lunches, housing and energy subsidies.

^cCorrection factor for sample selection bias.

welfare office) are higher for persons with disabilities.

Holding other influences constant, several factors in Table 15 significantly increase the value of food stamp benefits received by a family. These include residing in the Midwest or South, home ownership, and a family head who is a high school graduate. The correction factor for sample selection bias is negative and highly significant, indicating that our sample of FSP participants is not a random sample of the low-income population. We also note that the R-square for the benefits equation is small. However, low R-squares are not unusual in equations explaining food stamp benefits.²⁷

V. CONCLUSIONS AND POSSIBLE EXTENSIONS OF THE RESEARCH

The Food Stamp Program has unquestionably had effects on poverty, but due to measurement problems its impact in particular years and across time has been difficult to assess. Over the last two decades substantial progress has been made in advancing the theoretical foundations of poverty measurement, in data quality, and statistical tools of analysis that can be used to evaluate poverty. The advances permit a rigorous assessment of the effects of the food stamp program on U.S. poverty across time. The new developments include: 1) improved data with imputations for direct taxes and in-kind transfers, 2) the recognition that the official poverty line is arbitrary and that a different picture of the effects of the FSP may emerge if alternative poverty lines are considered, 3) recognition of

27. Moffitt (1989, fn. 3) reports R-squares for food stamp benefit regressions in the range 0.33 to 0.35.

considerable mobility both across the poverty line and among the poor in general, 4) the establishment of a formal relationship between the first two degrees of stochastic dominance and headcount and income gap poverty measures, and 5) the development of new statistical inference procedures for stochastic dominance, which allow for testing using both independent and dependent samples.

This study makes use of the five developments noted above and investigates the effects of the FSP on poverty in the United States in the 1980s. The principle findings are as follows:

- The effectiveness of the FSP at reducing poverty in any given year is sensitive to the poverty line chosen and the poverty measure (headcount or poverty gap) chosen.
- The poorest individuals (those with comprehensive equivalent incomes less than 25 percent of the official poverty line) receive smaller food stamp transfers than any other group below the poverty line for each of the five years considered. Holding economic and social factors constant does not change this result; however, this result is sensitive to the equivalence scale used.
- A comparison of the headcount reductions due to the FSP across time (1982 vs. 1990) are sensitive to the poverty line chosen. At the official poverty line and above, 1982 dominates 1990, while at three-quarters of the official line and below 1990, dominates 1982.
- In contrast, the poverty gap reductions due to the FSP are larger at each preselected poverty line cut-off in 1990 than in 1982. Thus, the FSP was more effective across time in reducing the income deficiencies of the poor at all poverty lines considered.
- The FSP reduces inequality among the poor, is progressive, and leads to only a small degree of "leap-frogging," or re-ranking between needs-adjusted families.
- The measured effectiveness of the FSP is enhanced if we evaluate poverty using a two year time frame and when we add imputed values of owner occupied housing. In contrast, inclusion of imputed values of medical benefits has little effect on the poverty reducing effects of the FSP.

- Neither program participation nor the level of transfers are related to the size of equivalent family income.
- The likelihood of participation in the FSP is higher for families that live outside the West, live in rural locations, receive other in-kind transfers, have small children, are nonwhite, female, or disabled. The likelihood of participation is smaller for homeowners, high school graduates and the older the head of the family.
- Equivalent food stamp benefits decline as the number of earners increases, with receipt of other in-kind transfers, when a small child is present, and as the age of the head increases. Equivalent food stamp transfers increase for residences in the Midwest or South, home owners, and high school graduates.

The original stated purpose of the FSP is to ensure that each eligible household should have "an opportunity to obtain a nutritionally adequate diet." (*The Food Stamp Program: Income or Food Supplementation?* Congressional Budget Office, January 1977). To assess the effectiveness of the FSP in achieving this goal, our report measures the impact of the FSP on the distribution of income among the poor. We further propose that adult equivalent per capita comprehensive income is the best available measure of "opportunity to obtain" an adequate diet.

It is also of great interest, however, to uncover whether the nutrient intake distribution itself is actually improved as a result of the FSP and whether the marginal effect of the FSP on the nutrient intake distribution changes over time. Recent work by Kakwani (1989) and Bishop, Formby, and Zeager (1992) has shown that the dominance evaluation methods, applied in this report to the problem of poverty, can also be applied to the related problem of undernutrition. Many issues addressed in this report would have a counterpart in an undernutrition study. For example, we have a nutrient intake requirement instead of a

poverty line and any single location for such a requirement is associated with a degree of arbitrariness. At any given poverty line comparisons can be made of headcounts of undernourished persons and of nutrient intake gaps. Issues of an appropriate equivalence scale also arise.

Furthermore, two potential microdata sources exist that could be used to carry out a stochastic dominance comparison of the effects of the FSP on undernutrition over time. One such possibility is the Nationwide Food Consumption Survey (NFCS) of 1977-78 combined with the NFCS of 1987-88. Questions have been raised about the reliability of the sample produced by the latter survey, but these questions may not preclude the use of the data required to construct a nutrient intake distribution. Another possible basis for comparison is the Puerto Rico supplement to the NFCS 1977-78 along with the 1984 Puerto Rico Household Food Consumption Survey. This comparison would have more limited applicability than the surveys conducted in the United States, but could be used to circumvent any major sampling problems with the broader surveys. The Puerto Rico surveys could also be used to rigorously test using the dominance method whether there are nutrition consequences of substituting cash transfers for food stamps. This important question was considered by Fraker, Devanney and Cavin (1986), but the dominance method is a superior evaluation procedure in that it considers the entire distribution of nutrients among the low income population.

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Appendix A

Procedure For Calculating "Adult-Equivalent" Income

The algorithm used to convert family income to "adult-equivalent" income corresponds to Cowell's (1984) Case E and is summarized as follows. First, the Orshansky threshold incomes¹ are normalized at unity for the average single person and the adult-equivalent income, y_i , is calculated by dividing household income by this index of needs. Next, the adult-equivalent income is converted to a per capita basis. For example, for a family of two adults and two children that has a total household income of \$10,000 the appropriate index of needs (from Table A1) is 1.95. Thus, $y_i = \$10,000/1.95 = \5128.20 is the adult-equivalent income. In calculating the poverty and inequality measures, this family is included by assigning four incomes of \$5128.20 each.

1. The poverty level threshold incomes used in this study are found in The Census of Population and Housing, 1980, Public Use Microdata Samples Technical Documentation (1983).

TABLE A1

Index of Needs*

Number of Household Members	Number of Children under Age 18								
	0	1	2	3	4	5	6	7	8
1 (age < 65)	1.00								
1 (age ≥ 65)	0.92								
2 (age < 65)	1.29	1.32							
2 (age ≥ 65)	1.16	1.32							
3	1.50	1.55	1.55						
4	1.98	2.02	1.95	1.96					
5	2.39	2.43	2.35	2.29	2.26				
6	2.75	2.76	2.70	2.65	2.57	2.52			
7	3.16	3.18	3.16	3.07	2.98	2.88	2.76		
8	3.54	3.57	3.51	3.45	3.37	3.27	3.16	3.14	
9	4.26	4.28	4.22	4.17	4.09	3.99	3.89	3.86	3.72

*Source: The Census of Population and Housing, 1980, Public Use Microdata Samples Technical Documentation (1983)